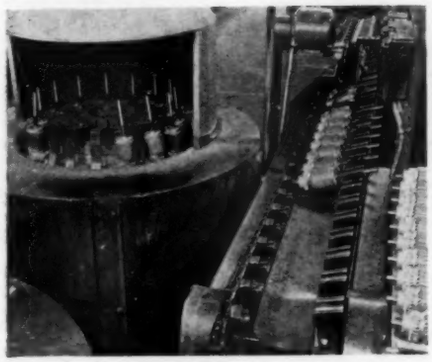
AMERICAN MACHINIST

June 28, 1939



Self Starters—*Efficient production of small motors depends largely on well planned material handling (page 468)*

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History in the Making— the Machine Tool Show

★ THIS ISSUE of *American Machinist* carries the official announcement of the great Machine Tool Show to be held in Cleveland this fall. The Show will be important as portraying the place of the machine tool in metal-working today—it will also have an important meaning for your business.

Your visit will help you increase profits in your own plant. You will find the major machine-tool and machine-tool-accessory developments of the past four years there assembled. New ideas of wide application to your own production problems will be presented. And there will be unlimited opportunity to discuss applications with the men who have designed and produced the equipment displayed.

Metal-working history will be in the making at Cleveland, October 4 to 13. You should plan your visit now. Watch this page for details on how to get the most out of the Machine Tool Show.

★

AMERICAN MACHINIST ***plans a complete description of the Machine Tool Show in its September 20 issue. Timed to allow you to budget your visit, it will save valuable minutes and hours at Cleveland.***

ESTABLISHED 1877 **AMERICAN MACHINIST** BURNHAM FINNEY, Editor

1940 PROFITS

By WENDELL E. WHIPP
President, Monarch Machine Tool Company
President, National Machine Tool Builders Association

You intend to make more money in 1940 than you are going to make in 1939.

How are you going to do it?

It cannot be done sitting around hoping for things to get better. Certainly by this time all of us should be aware of that fact.

Will Congress have taken some of the tax burden off our shoulders by 1940? Your guess is as good as mine. I doubt it.

What about wages? Do any of you expect that in 1940 your company will be able to make more money by the simple device of paying less to your employees? That sort of thinking simply does not belong in today's social, economic or political picture.

Will you be able to cut down on overhead, salaries, insurance and miscellaneous expense? Or has that been pared to the bone already?

The fact is that with taxes, wages, overhead and so many items of expense practically crystallized, and with little prospect of much change in these matters, increased profits can come only from increased sales or decreased production costs. Either you must sell more, or make more money on what you sell.

If you plan to make more money on the same volume, unit production costs in the plant must be reduced. And since wages will probably remain where they are, the only avenue left for the cutting of unit production costs lies in better and more modern equipment—particularly machine tools.

Now let us take the other premise. Suppose you plan to make more money next year by increasing your volume.

If business conditions remain on the whole much the same next year as they are this year—or at least much the same as they have over the past few years—do you think you can get greater sales volume by simply continuing to turn out the same product at the same price?

In the face of today's competition to increase your sales volume you must either turn out a better product, to sell at the same price; or a product just as good, to sell at a lower price. If you want to show a real sales upturn, give your customers both a better product and a lower price.

How? Here again there is only one answer—the cutting of unit production costs by the installation of more efficient production equipment.

There is nothing new about this story. It is the backbone of American business history. Industrial progress has been made in this country by progressive mechanization which has made it possible for manufacturers to turn out constantly better products at constantly lower prices, which in turn led to increases in volume. Profits came hand in hand with *volume*.

To get greater volume, you must offer a buying incentive. You must be able to give the customer more for his dollar than he ever got before. To do this, you in turn must be able to get more for your production dollar. How? The only single avenue which today does not appear to be closed by economic or political obstacles is the avenue of improved and increased mechanization.

There is no law, political or economic, even today, to prevent a machine tool operator from turning out twice the production on a new machine tool that he now turns out on an old and worn-out machine tool.

There is no twisting of arithmetic that will alter the fact that this increased productivity cuts unit costs of the product produced.

With the savings in production costs effected by better mechanization, there will be a margin to play with. A company can put more quality into its products, to sell at the same price —or it can keep quality where it is, and sell at a lower price.

In either event, the company does not have to pass on to the customer all of the savings effected by its modernized equipment. It gives the customer more; but it likewise has more left for itself. And above all—the company has a new sales inducement to offer in quality or price, or both.

That is why the Machine Tool Show to be held in Cleveland in October this Fall may prove literally to be the key to 1940 profits for countless manufacturing enterprises all over these United States.

Gathered together in that Show, under one roof, will be thousands of examples of exactly how the manufacturers of this country can cut unit production costs and increase productivity per dollar expended.

I am not going to attempt to go into detail as to the advances in the art of building machine tools which have taken place since the last Machine Tool Show. It is enough to say that I know from my own observation that these advances are so substantial that any manufacturer who fails to familiarize himself with them would simply be in the dark if he attempted to figure production costs upon a competitive basis.

I recommend a visit to the Machine Tool Show in Cleveland this October as the foremost step in planning profits for 1940.

Where Starters Start

I—A smooth production tempo is assured in Delco-Remy's new plant by application of the latest methods for machining, heat-treating, assembly and handling

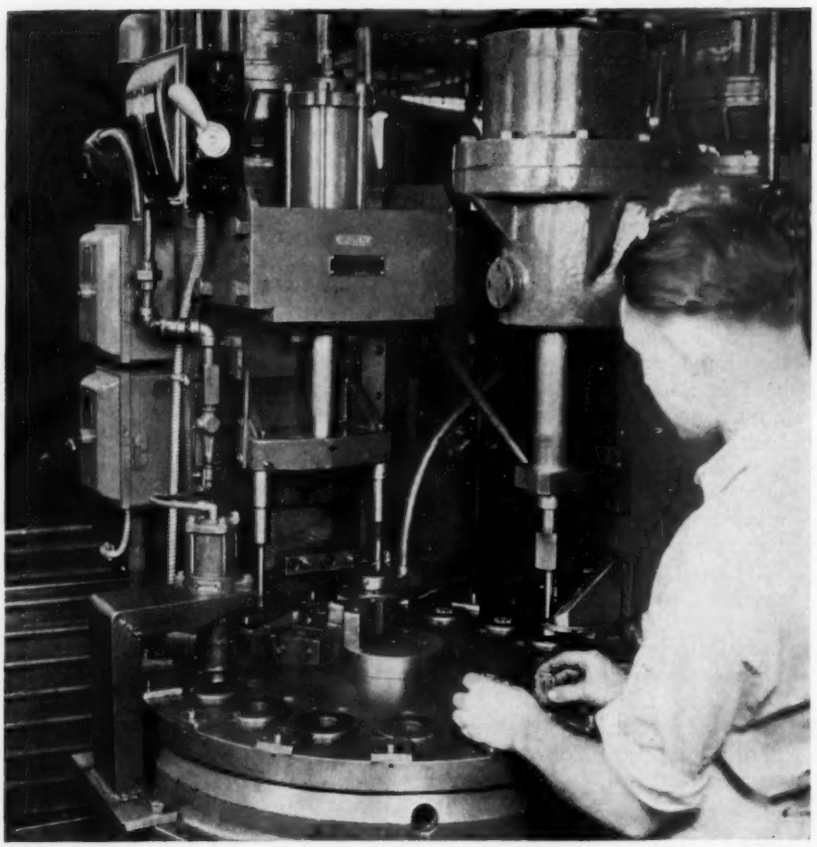
By RUPERT LE GRAND
Detroit Editor, American Machinist

LITTLE MORE than a year ago the Delco-Remy Division of the General Motors Corporation placed in operation a new building laid out and equipped solely for starting-motor production. Approximately 8,000 starters are produced per day by 750 operators; although most of the starters are shipped to various General Motors passenger-car divisions, some are for heavy-duty gasoline and diesel engines.

Several G.M. divisions use the same starter-frame size but some of them specify additional field coils for greater starting loads, different relays or mechanical linkages thereof to suit the particular design of car. Nevertheless, standardization of components wherever possible has simplified manufacturing and assembly problems. A high percentage of actual operating time of the various manufacturing lines for sub-assemblies has been achieved, which requires the use of but two final assembly lines for passenger-car starters.

The main components of the starters are produced on machining and assembly lines stretching from rear to front of the building, where they are placed on a transfer and storage conveyor. Very few parts are trucked to the final assembly department at one end of the building. Sub-assembly lines are thoroughly equipped with belt conveyors, slides, chutes and merry-go-round conveyors to advance the work from station to station without fatigue. Ingenious assembly machines and fixtures, hoppers, bins and magazines are supplied profusely to avoid vexatious fumbling.

Production of the starter-clutch assembly is typical of advanced manufacturing engineering. The starter clutch is the component that has superseded the old-type Bendix drive. Actually it is an over-running clutch. This device consists of two major sub-assemblies: (1) the shell and sleeve, and (2) the pinion and collar, plus four very small springs, four small rollers, spring holders and a larger spring. Parts for the two major sub-assemblies are made in the automatic and gear-cutting departments and delivered thence to two sub-assembly lines. The nickel-steel pinion and the collar are pressed together, and a copper ring is slipped over the pinion next to the collar. These two parts are then fixed in relation to each other by brazing in an Electric Furnace hydrogen furnace.



Slotted, graphite-filled bushings are pressed into opposite ends of the pinion-collar assembly at the first two stations of this Logansport machine. A burnishing tool aligns the two bearing surfaces at the third station

The next major operation is gas carburizing in a battery of rotary furnaces. Following this, the pinion-collar assembly is hardened in an automatic cyaniding machine that also serves the other sub-assembly line. Cleaning in a Wheelabrater Tumblast conditions the piece for pressing in two bushings in a dial-feed machine. At the first station a bushing is pressed in one end of the pinion and

By chucking the pinion-collar assembly on a Cincinnati for grinding the outside diameter of the collar, greater output is obtained than by the former method of placing the part on a mandrel for cylindrical grinding

Four cam slots in the shell are broached on an American 20-ton machine equipped with four magazines and a slide that advances four parts to the four broaches at each cycle

A small spring is loaded onto each of four pneumatically actuated plungers and entered into holes leading from the shell periphery to the cam slots

collar. At the second station another bushing is pressed into the other end. A gap is purposely left between these bushings for a grease reservoir. At the third station a burnishing tool is run through the two bushings, which are of the slotted graphite-filled type.

As the next operation, the collar is ground on the outside diameter in a battery of two Cincinnati chucking grinders tended by one operator. Production attained is 800 pieces per hour per man. After inspection for size and eccentricity, the pinion and collar sub-assembly is passed to a short merry-go-round conveyor where it is assembled to the other components of the clutch.

In making the shell and sleeve subassembly, the first operation on the shell is copper plating to keep the body of the part soft while being carburized. Four internal cam slots are then broached, and the slots are hardened by carburizing to a case depth of 0.040 in.

Meanwhile an end plate having four projections is copper brazed to the sleeve. The first step in assembling the sleeve end plate to the shell involves a press set-up that squirts the end-plate projections into four holes drilled in one face of the shell, and stakes the rim of the shell over the end plate. Internal splines in the sleeve can now be broached in accurate relationship to the shell.

The shell and sleeve assembly is then cyanided in automatic Continental equipment which also serves the pinion and collar assembly. This automatic heat-treating machine consists of (1) a gas-fired pre-heating chamber, (2) an Ajax-Hultgren salt bath, and (3) an oil quench. Automatic transfer mechanisms carry racked work into and out of the three stages in timed sequence. Washing

and shot blasting condition the work for drawing in a Lindberg "Cyclone" gas furnace. After cleaning, final staking of the end plate to the shell is done in a second press set-up. The shell and sleeve are now ready to join other components of the clutch for final assembly.

As the two sub-assemblies of shell and sleeve, and pinion and collar leave their respective production lineups, they are transferred to a merry-go-round departmental final assembly conveyor. Preliminary operations are mainly inspection and greasing. Farther on, the operators remove the shell and sleeve from conveyor pans for insertion of cam rollers. An automatic sorting and distributing machine drops the rollers correctly positioned into the cam slots. At a suc-

ceeding station, four plunger springs must be inserted. These springs are long, small in diameter, and must enter holes so that a retainer cap can be slipped over them. The operator puts the sleeve-end down into a ring chuck and slips a spring on each of four mandrels. Tripping a pedal causes the mandrels to advance under pneumatic power to enter the springs into the holes in the shell. These holes run at an angle from the periphery to the cam slots. The retainer cap is slipped over the shell and the loose assembly is passed to the next operator for crimping the retainer in place. A torque inspection determines whether there is any binding in the assembled clutch to cause trouble by preventing disengagement as the motor picks up speed. Assembled clutches can now be transferred to the final starter assembly department.

Armature laminations are transported by chain conveyor from blanking presses to an assembly station. Laminations are whirled in a centrifugal to remove oil, weighed (counted by a scale) and dropped over oscillating mandrels. These have a feather key that engages with a key slot cut into the disk hole for the sole purpose of providing a means of aligning the disks. The stack of disks is then passed to a hydraulic press where the armature shaft is pressed in. The next station is an automatic roll-feed and cut-off machine that lines the lamination slots with a paper quill, indexing the armature and inserting formed paper made from a strip at each slot.

The armature then goes along one belt of a double-deck conveyor, and an adjacent press set-up drops hairpin conductors on the other belt. Women operators at the conveyor, pick off the armature and insert the hairpin conductors in the slots. They drop the partially made assembly onto the belt again. At the take-off end of the conveyor, an operator removes the armature and places it in an air press for pushing the hairpins all the way through the slots. Later press operations crimp the free ends of the conductors in toward the commutator location and twist the ends. The commutator is then pressed in, and the commutator riser bars are crimped over the conductors.

The assembly is dropped onto a short crosswise chain conveyor for fluxing and movement to automatic soldering machines. Wirebrushing follows to remove excess solder. Armatures are racked on a multiple-chain conveyor that takes them through a varnish dip for impregnation and a baking oven in a monitor at the front of the building. When the baked armatures return to floor level they are unracked from the conveyor and ground on the outside diameter of the laminations. As the last operation the commutator is turned and sanded on a four-spindle New Britain-Gridley, which also removes excess conductor ends.

A short feeder line makes commutators for the armature line and portrays unusual skill in assembly methods. In a rectangular grouping, an automatic press at one rear corner makes thin commutator risers from tin-coated copper strip. These are stacked automatically, and removed by the hundreds in a stacker slide to a central assembling machine. At the other rear corner of the rectangle, another automatic press makes commutator bars from wedge-shaped copper strip. An inspecting machine drops acceptable bars onto an overhead conveyor that transports them to a second sorting and arranging machine. This machine delivers the bars into a magazine, from which they are removed to an assembling machine by a stacker slide.

At the assembling machine, stacker slides for riser bars, a mica slot insulator and commutator bars are arranged to deliver these parts to sets of automatic assembling fingers. The latter push out a correctly arranged stream on either side. An operator removes a gaged length of the pieces, arranges them in a circle and snaps on a spring-steel retaining ring.

Loose assemblies of commutator bars are passed to three operators who place mica and steel rings in both ends and loosely insert a steel core. After a light staking of the core to hold the assembly together, the commutator is baked to drive the binder out of the mica. Succeeding operations stake the core firmly and spread the riser bars to admit the conductor bars. Inspection follows on an automatic machine that throws out any commutator that fails to pass a 500-volt test for grounds or shorts.

Other production lines running from the rear to the front of the shop produce such starter components as clutch-end bearings, frames, shafts, field coils, pinion housings and switches. Most of these production and sub-assembly lines feed directly to the conveyors running along the front of the shop to carry parts to the final assembly department at one end of the building. The degree to which this 560 x 300-ft. building is conveyorized is shown by statistics as follows: 5,089 ft. of conveyor chain, 3,400 ft. of conveyor belts, and 1,000 ft. of gravity conveyors.

Stacker slides filled with commutator bars, tin-coated riser segments and mica slot insulators are loaded from adjacent presses and inspection machines. These are then placed on this automatic assembling machine that feeds out two streams of bars, risers and slot insulators in the correct sequence

A second article on Delco-Remy production methods will appear in an early number.

O.K. for the Air

By LYMAN C. MASON
Machine Shop Inspection
North American Aviation, Inc.

MACHINE SHOP INSPECTORS at North American Aviation are selected both for their general mechanical knowledge and for their special familiarity with aircraft parts. The majority of the men are experienced machinists or toolmakers who have demonstrated that they possess mature judgment. The average age of the inspectors exceeds 40 years.

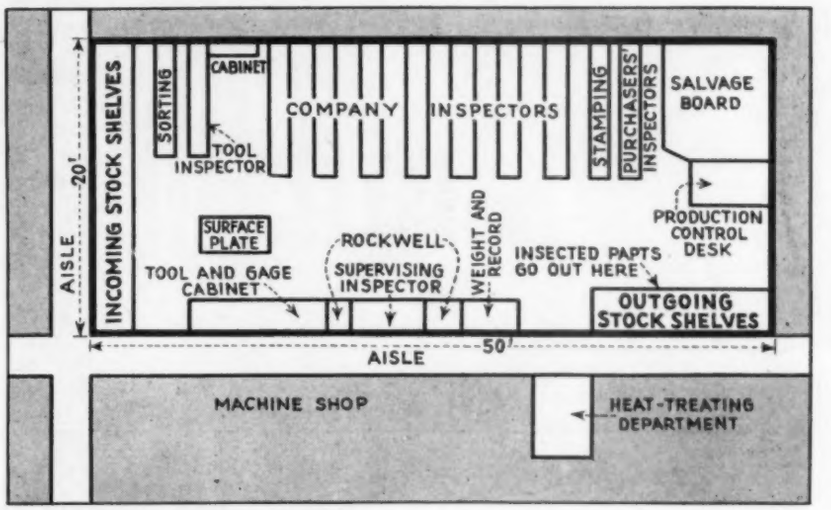
A supervising inspector is in charge of the inspection booth. His duties include the assigning of work, approval of rejections and reworks, and assisting in the interpretation of new prints. Inspectors are usually assigned parts with which they are most familiar, resulting in a material reduction of inspection time. Junior inspectors stamp parts for inspectors and run errands.

A production control man is stationed in the booth to give priority to urgently needed parts and to split work consignments when necessary.

A tool inspector, whose duty it is to check and set plug, snap and ring gages, is available at all times.

All parts are stamped with the number of the inspector who tested them. Each inspector has three stamps: one of metal for stamping metal parts, one of rubber for stamping parts, which do not permit a metal stamp, and one small stamp of rubber for the inspection record on work tickets. All parts are numbered or metal tagged with part numbers. If the material has been heat-treated, an "H.T." stamp is placed beside the inspector's; if Magnafluxed, an "M.F." stamp, etc. If the part has been inspected by the purchaser's inspector, his stamp is also affixed.

Plating on machined parts is checked by the man who makes the original inspection of the part, and plating that appears defective is rubbed with a soft rubber eraser, which cleans but does not injure the plated surface. To prevent galling and sticking of gages in plated parts, clean vaseline is applied to the gages before insertion. All external threads are wrapped with masking tape to prevent damage, and polished surfaces are protected by proper packing.



The inspection booth is directly adjacent to the machine shop. Only inspectors are permitted inside the booth; parts are placed on incoming shelves, inspected and then placed on outgoing shelves on the opposite side of the booth. By this method, all stock-moving is accomplished from the outside, and there is no possibility of crowding or confusion within the booth.

The booth is airy and well lighted. Benches face north, with ample light provided by the sawtooth roof. For night work, mercury shadowless lamps are used. Neatness is required, and the booth is kept clean and orderly at all times.

Each inspector is provided with a bench, 30 x 72 in.; a comfortable stool; a surface plate 18 in. square with a wood protective cover; a self-oiling block for hardened and ground bars; a block of drills up to ½ in. in diameter. Inspectors use their own hand tools, subject to checking by the tool inspector.

Cabinets are provided to accommodate all company-owned tools, such as vernier height gages and calipers; inside and outside micrometers; dial indicators; parallels; plug gages; plug, ring and snap thread gages; special gages; templets; and angle plates. Cabinets are so arranged that each tool has its own place and does not rest against another. For larger work, a 3 x 6-ft. surface plate is also provided.

A separate cabinet is provided for measuring wires, set plugs, and master gages. The majority of the threads inspected are Class 3; a Pratt & Whitney super-micrometer may be used on them with satisfactory results. A Rockwell machine, calibrated to B and C scales, is housed on its own base in a dustproof cabinet.

Rejects. Inspectors are instructed to state reasons for rejections simply and factually in order to avoid misunderstanding, and all notations on rejection orders are required to be printed rather than in longhand. In case of rejection, parts are sent to a salvage board for disposal, and the inspector is relieved of further responsibility. Whenever possible, reworked parts are returned for inspection to the man who made the original inspection; otherwise they are 100 per cent reinspected.

The inspection staff is constantly encouraged to apply its ingenuity and experience to the end of improving inspection and production methods. Suitable forms are provided upon which inspectors are urged to suggest drawing changes that they believe will help to make a better product.

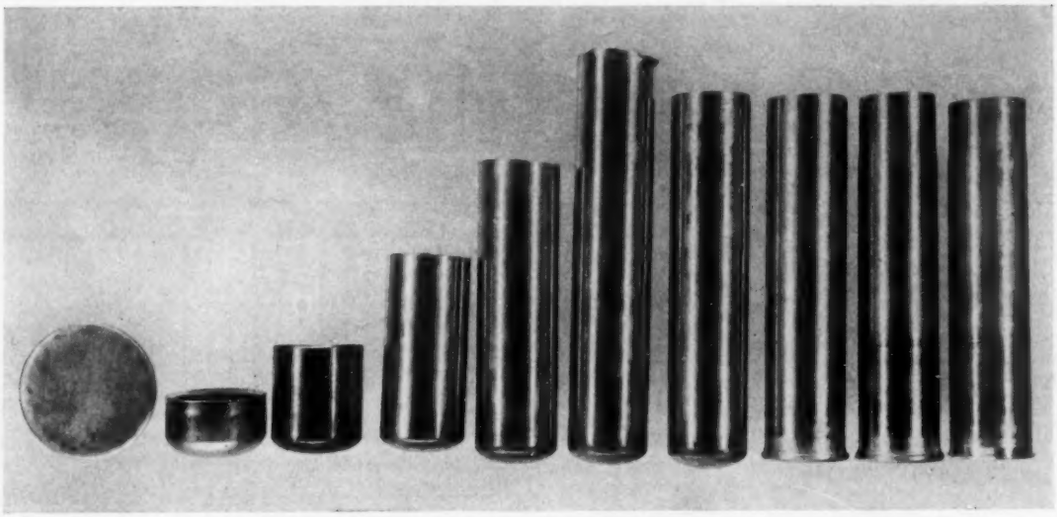


Fig. 1—Here may be seen the disk, the cup, the four draws, the trim, the heading, the tapering and the machined head. The case is representative, in general, of all other types of cartridge cases

Artillery Ammunition

By LIEUT. COLONEL LEVIN H. CAMPBELL, Jr.
Officer-in-Charge, Artillery Ammunition Department, Frankford Arsenal

CARTRIDGE cases are used in "fixed" ammunition; that is, the base of the shell is inserted in the mouth of the cartridge case and securely held by means of crimping the case to the projectile. By "fixed" ammunition is meant a round of ammunition complete with shell, fuze, cartridge case and propelling charge, which may be handled as a unit by the gunner. In general, cartrdige cases are not used for rounds of ammunition exceeding 6 in. in diameter; the round becomes too heavy for ready handling if larger sizes are used.

A cartridge case serves a dual purpose, in that it holds the smokeless powder propelling charge, and upon the firing of the charge, by its expansion against the chamber walls of the gun, effectively obturates or seals the powder gases, preventing their escape to the rear against the breach block. If such obturation is not had, some of the powder gas pressure is lost to its true function in acting against the base of the projectile. A percentage of muzzle velocity, with resulting range, is thus lost.

We, at Frankford Arsenal, have within the very recent past largely modernized our cartridge case shop equipment, including presses, annealing furnaces and machines, so that we feel we have set up a plant which represents the greatest possibilities for mass production in a minimum of time and cost. Our shop is small and we have no ambition to enter into large scale production. We have, we believe, secured a set-up which represents the best thought in the art of cartridge case manufacture and which will serve as a laboratory of production.

Here may come manufacturers who are interested in bidding on such contracts as the War Department may contemplate placing with commercial concerns. Here will be seen modern, high-speed production equipment, together with all the necessary working and inspection gages. Route sheets and tool and die drawings which have been submitted to the test of small scale production are available. Mass production, obviously, will be reached by increasing the items of presses and other equipment which we have in use.

For the purpose of this article, I intend to describe the manufacture of the 75-mm. brass cartridge case used by the Army. Fig. 1 shows the various stages in the manufacture.

We purchase from commercial sources a brass disk 5.415 $\pm$ 0.10 in. in diameter, 0.450 $\pm$ 0.010 in. thick, weighing 3 lb., 2 oz. This is of cartridge brass, which has a composition of 70 per cent copper and 30 per cent zinc. These disks are carefully inspected to see that no cracks, seams or other flaws are present. Such imperfections, if not detected, are carried forward in manufacture, and we find ourselves with an unacceptable case, with not only the loss of the brass disk, but labor expended on the case.

We manufacture a multiplicity of cartridge cases of varying sizes.

This article is released for publication by the Chief of Ordnance, U. S. Army. Statements and opinions are to be understood as individual expressions of their author and not those of the Ordnance Department.

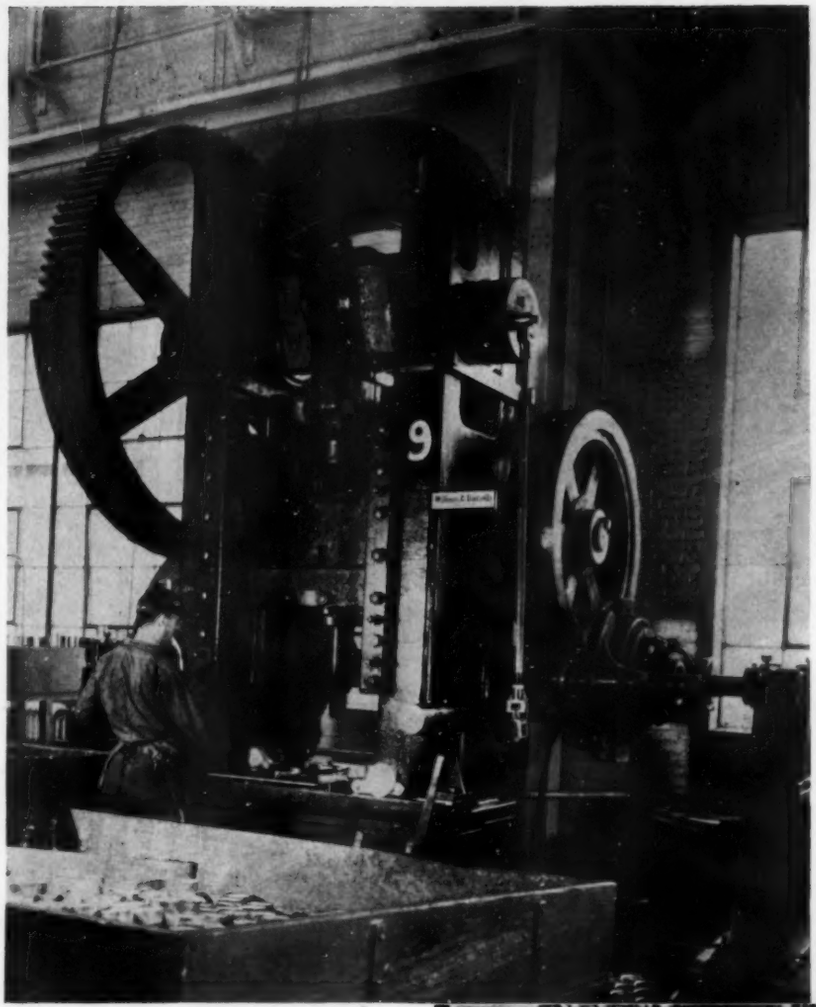


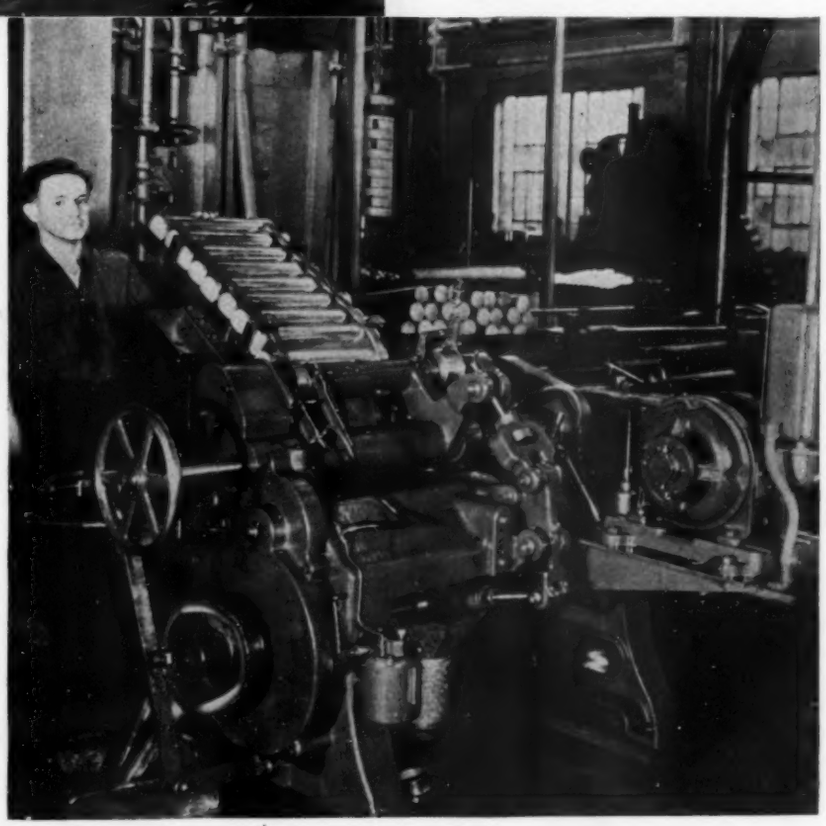
Fig 2—Although the 75-mm. case requires but 110 tons pressure for the cupping operation it is done in a 225-ton capacity Bliss mechanical crank press

The next operation is what is known as the first draw, which is done on a 150-ton Toledo mechanical press. Actually, a 75-ton press will perform the operation. The thickness of the wall at the lip of the cup, which is 0.290 in., and the height of the wall, which is 0.9375 in., is reduced to a thickness of 0.125 in. and increased to an approximate length of 3.8125 in. The part must again be thoroughly annealed at the same temperature for the relief of drawing strains, receive a pickle for the purpose of removing scale and a wash for removing any residual acid.

We are now ready for the second draw, which is done on a 150-ton Bliss hydraulic press, and in which the wall thickness is reduced to 0.065 in. and the length increased to approximately 6.9375 in. Fifty-five tons pressure is required for this operation. The usual anneal, pickle and wash is given.

The third draw is now given on a

Fig. 3—The V. & O. special trimmer consists essentially of a hopper feed, an arbor to hold the case and a circular trimming cutter



Therefore, in the purchase of our equipment we have tried, insofar as possible, to specify presses which, within fair limits of efficient operation, will handle a number of sizes. For this reason, in the description below it will be found that we are using presses greatly overrated for the particular operation. This, however, cannot be helped within the limits of our available funds. We must agree that such use is not without merit, in that invariably when a piece of equipment is operated at under-capacity, its accuracy life is considerably increased, and maintenance charges are usually low.

Our first operation is known as cupping, shown in Fig. 2. By this operation we have completed the first forming of the disk. It must then be thoroughly annealed at 1,150 F. to remove working strains. All annealed work is cooled by a shower of water. We then pickle in a 5 per cent sulphuric acid solution, after which the cup is thoroughly washed to remove acid, as a safeguard against future season cracking.

75-ton Bliss hydraulic press, during which draw the wall thickness is reduced to 0.038 in. and the length increased to 11.0625 in. The actual drawing pressure required is 25 tons. An anneal, pickle and wash follow.

The fourth and final draw is accomplished on a 50-ton Bliss hydraulic press, and the wall thickness is further reduced to 0.032 in. and the length increased to approximately 14.875 in. Actually, 12 tons are required.

The metal under greatest stress is, of course, that at the mouth end of the closed cylinder, and in order that this highly worked metal may not remain as a part of the finished case, approximately 1½ in. of metal are trimmed off in a high-production V. & O. special trimmer, which was made to our specifications. Fig. 3 shows this machine in operation.

We must now head the case, that is, form the base of the cylinder after the fourth draw, so that we will have the base flat and with a sufficient lip, so that the case may be extracted from the gun after firing. This operation, requiring 675 tons pressure, is done on a 1,000-ton dial feed H-P-M press, shown in Fig. 4.

In order to remove the possibility of cracking the case at the mouth end during the tapering operation, the case is dipped to a depth of 4 in. from the head, for a time of two minutes, in a salt petre bath at 950 F. This removes all strains and softens the mouth and neck of the case. Firing a cartridge case in the gun, of course works and hardens the metal. Should a case be fired too many rounds without resizing and annealing, longitudinal splitting, usually at the neck, occurs.

The next operation is that of tapering the case at the mouth to a diameter approximately equal to that of the shell, Fig. 5.

We are now ready to perform the operations of completely machining the head of the case. This is done on an eight-spindle Bullard Multi-Matic. This machine is so designed that the same operations are being simultaneously performed on two cases. The output of the machine is consequently very high. The machining operations consist in drilling, counterboring and reaming the primer hole, and in facing the head of the case, and turning it to the required diameter and thickness of extraction lip. A total of five operations is performed with five tools. After this operation, the case goes to a high-production trimming machine for trimming to exact length. This trimming is, of course, performed on the mouth of the case. A wash to remove oil and dirt is next given.

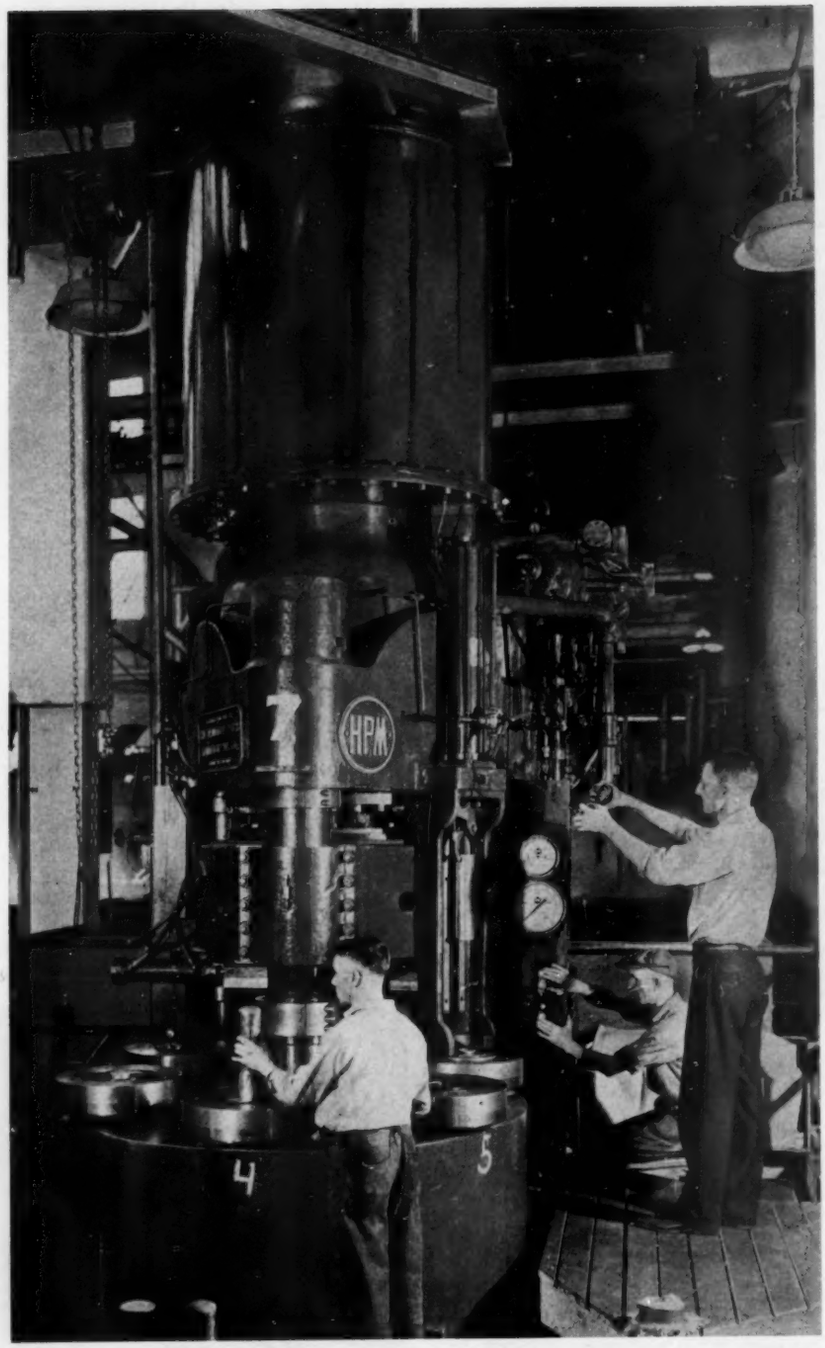


Fig. 4—One application of power is sufficient to form a base in the interior of the head of the case and to make an indentation in this base, so that the metal will be as hard at this point as it is practical to make it. Hardness at this point provides a primer seat of maximum life against blow-back of the powder gases within the case when the round is fired.

The case is now stamped with information giving the size, model and lot number. We must again anneal the mouth by dipping 2 in. of the open end in a salt petre bath for two minutes. We here repeat the washing operation. Every case now receives a most careful inspection for compliance with drawing dimensions and character of finish.

Artillery cartridge cases, it has been found, when stored for long periods of time develop season cracks, which, of course, result in their complete loss. We have, therefore, introduced at this point of manufacture a low temperature anneal, which is given for 50 min. at 550 F. This temperature is not enough to affect the hard-

Fig. 6—This microphotograph represents the structure of an annealed draw piece indicating the maximum grain size obtainable at 1,150 F. in a 75-mm. cartridge case and which is the maximum temperature prescribed

ness or grain structure of the metal in the case, but does thoroughly relieve all residual strains incident to manufacture. For this work, we use a belt-type continuous annealing furnace made for us by the Surface Combustion Corporation. For smaller cases, we also have a box-type furnace made by the same company.

The cases are now packed, 25 to a box, in cardboard cartons and are stored until such time as five samples, representing a lot, which have been sent to the Proving Ground, have been accepted for functioning. This functioning test consists in using a case during the firing of five rounds. Cases are resized after each firing, except the last. If obturation of both the case and primer in the base are satisfactory, as required by the specifications, and if no cracks or deformations have appeared, we are then given instructions to ship the entire lot of cases represented by these ballistic samples to the loading plants.

During the entire course of manufacture, a close laboratory check is maintained as regards the grain structure of the metal after each of the various operations of drawing and annealing, as above described. Too much stress cannot be laid upon the necessity for this accurate check, if losses in drawing and in firing are to be avoided. Fig. 6 shows a typical grain structure which has been found satisfactory.

We have, within the past year, employed carbide dies in our drawing operations. The use of these dies has resulted in greatly improving the quality of our cases and has increased die life. Our practice as regards dies is, when one has become worn beyond the allowable tolerances of its particular operation, to regrind and place it on the preceding drawing operation. The use of carbide dies has, of course, greatly reduced our toolroom cost of die upkeep. The punches used in cartridge case manufacture are from tool steel, such as is supplied by any number of high-grade sources.

With the use of our modern equipment, we have increased the speed in feet per minute on all drawing operations. The war-time crank press usually had a fixed stroke, and much time was lost by the slow movement of the punch in that part of its cycle where it was merely engaged in traveling upward from the work and downward in its return to the work. A modern hydraulic press is so designed that the non-productive part of the stroke is very rapid, usually 100 ft. per min. The working portion of the stroke is regulated to the maximum allowable drawing speed, which we have found to be 35 ft. per min. for the first and second draws; the third is 30 ft. per min., and the fourth, 25 ft. per min. We are constantly experimenting in cartridge case manufacture to reduce the number of draws, with consequent reduction in the number of anneals, pickles and washes, with the extra handling involved. In some instances, we have made reductions from eight to seven, and seven to five draws; in others, from five to four, and in others, from six to four. This is largely a matter of drawing speeds, die design, grain structure and accurate annealing. Such work, of course, is constantly going forward and we hope to reach the point where we can further reduce these operations.

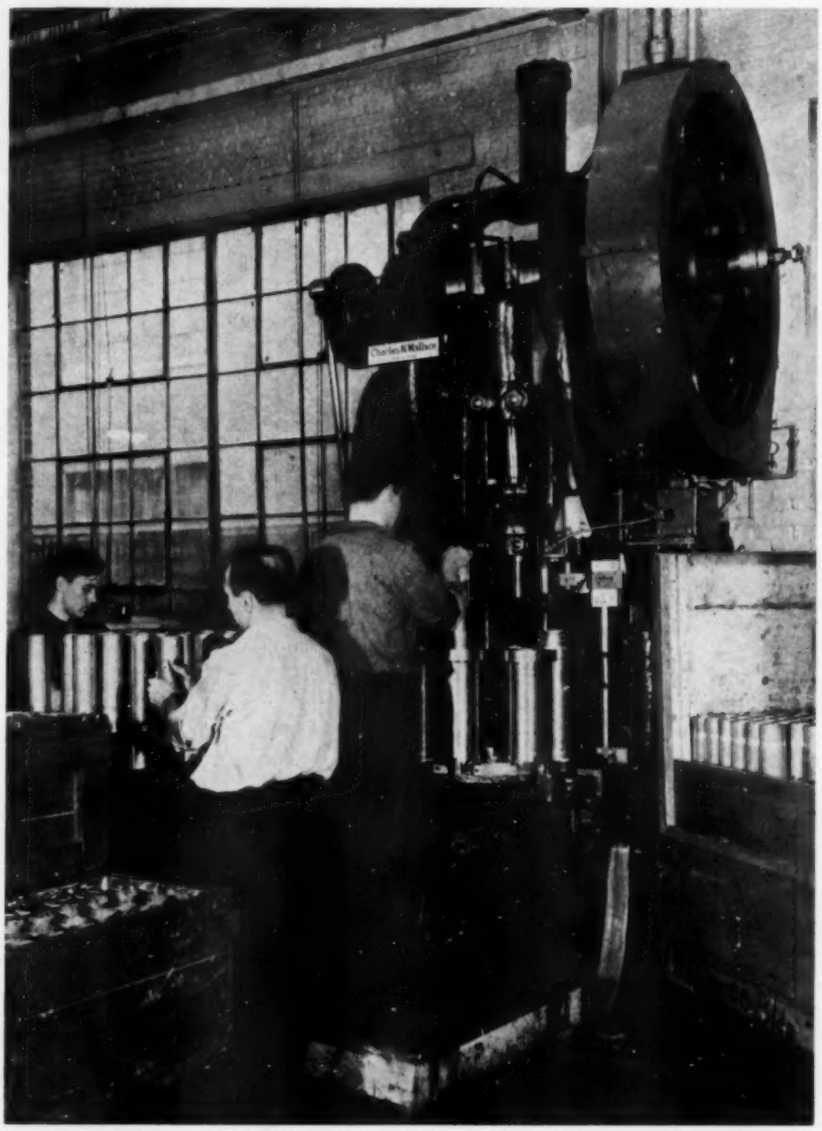


Fig. 5—A Ferracute dial-feed tapering press tapers the case at the mouth in one stage and lifts it automatically for easy removal

Forming Dies

Often the die designer can choose a principle that does the job in one operation instead of in two more common set-ups

By C. W. HINMAN
Tool Engineer
Kobzy Tool & Electric Mfg. Company

USEFULNESS of the spring-pad principle in bending and forming dies is shown by Fig. 135. The blank is placed within a nest of four notched plates *A* and is located across spring-pad *B*. When the forming punch descends on the blank, the pad and work recede together, thus "throwing up" the ends of the blank within the sides of the die. At the bottom of the stroke, the pad registers on the floor of the die opening; the punch then gives the formed work a definite set.

The spring-pad is actuated by a spring-plate "bumper" beneath the die shoe. When the ram ascends, the spring-pad causes the piece to follow the punch until the pad becomes flush with the die face. As the ram continues to ascend, the work is removed from the punch by contacting the two stripper hooks, or fingers *C*. If stripper hooks interfere with placing the blanks, the knock-off rod shown can be employed instead. When output is sufficiently large a magazine can be used to feed the blanks.

Bending in opposite directions simultaneously is easily accomplished by using the principle set forth in Fig. 136. For bending pieces, such as shown in Fig. 137, the blank is laid on the face of die channel *A*, between the end gages *B*, and the side pins shown in section *X*—*X*.

When the ram descends, two spring-pins through punch *C* contact and hold the blank, while bending punches *D* start bending down the ends of the work. Punch *C* then contacts the blank, and carries it down into the die channel *A*, against spring-pad *E*. This action "throws up" the sides of the work against *C*, and thus forms the channel. When the spring-pad registers in the bottom of the die, the work is spanked to size and shape. Near the top of the stroke, knock-off rod *F* contacts the bar through the press slide and strips the finished piece.

If the press is operated by the diesetter when the knock-out bar is set

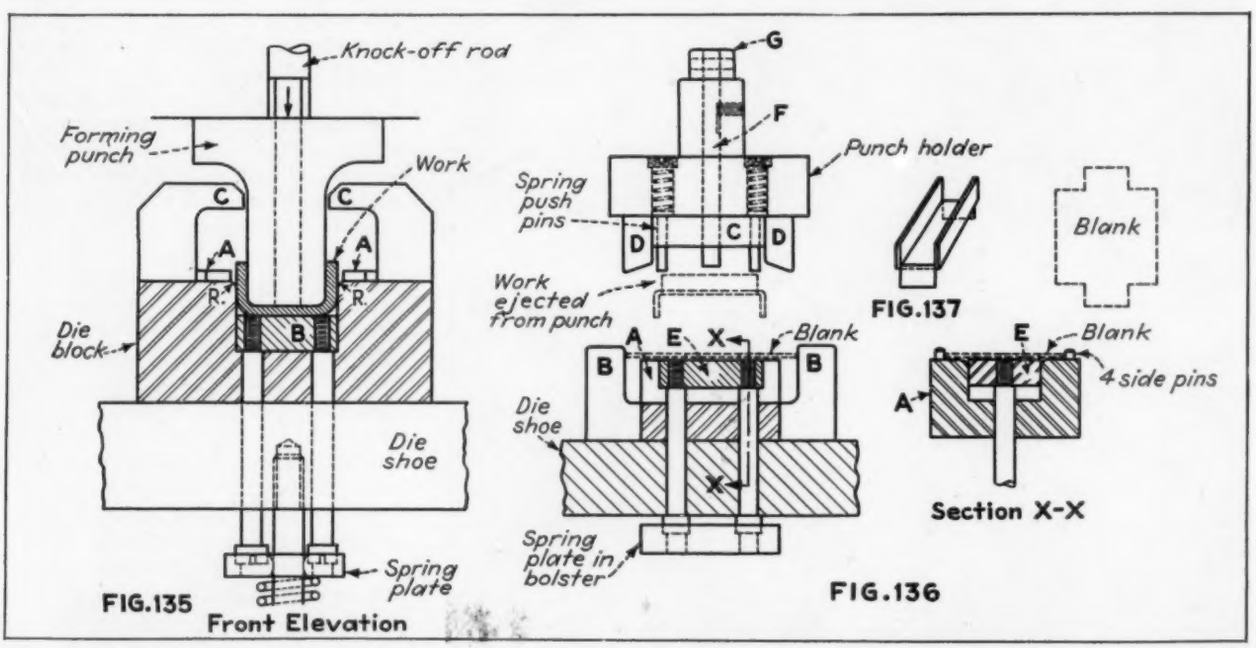


Fig. 135—Work is stripped from the punch either by hooks C *or by a knockout rod. Fig. 136—Side punches* D *form the ends of the work down, and punch* C *pushes the work into die channel* A *to form up the sides of the part*

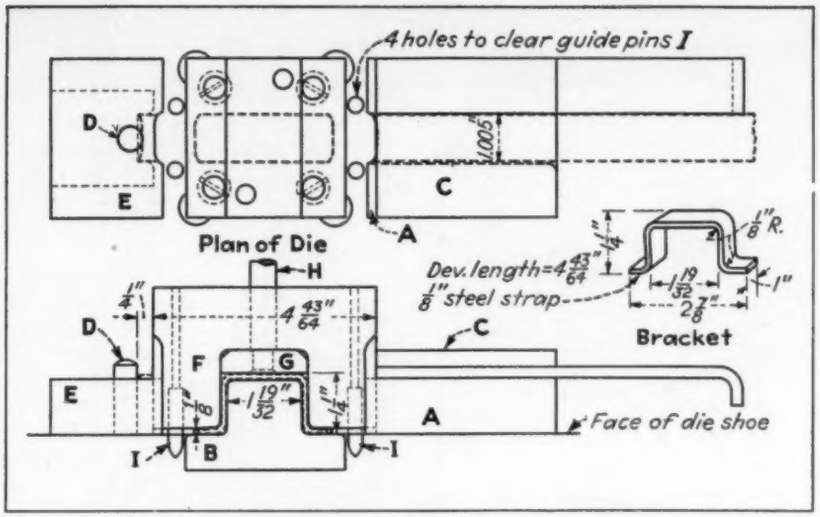


Fig. 138—When this die is used on an inclined press, the ejected work slides off to the rear

bending four angles, as at *A*, in a previously cut blank. The tool is shown in three stages of operations at *B*, *C* and *D*. At *B*, the die in descent is in contact with the blank. At *C*, the die has completely thrown up angles *E* on the work. At *D*, the die has reached the bottom of the press stroke, the entire piece is completed, and all the angles have been spanked square. A knock-out rod ejects the piece from the die when the ram ascends.

A die with side forming cams is sketched in Fig. 140, together with the finished piece *A*. The blank is positioned between stops, not shown but fastened on the tops of the side forming cams, or slides, *B*—*B*. When spring punch *C* descends on the blank, and before the side punches

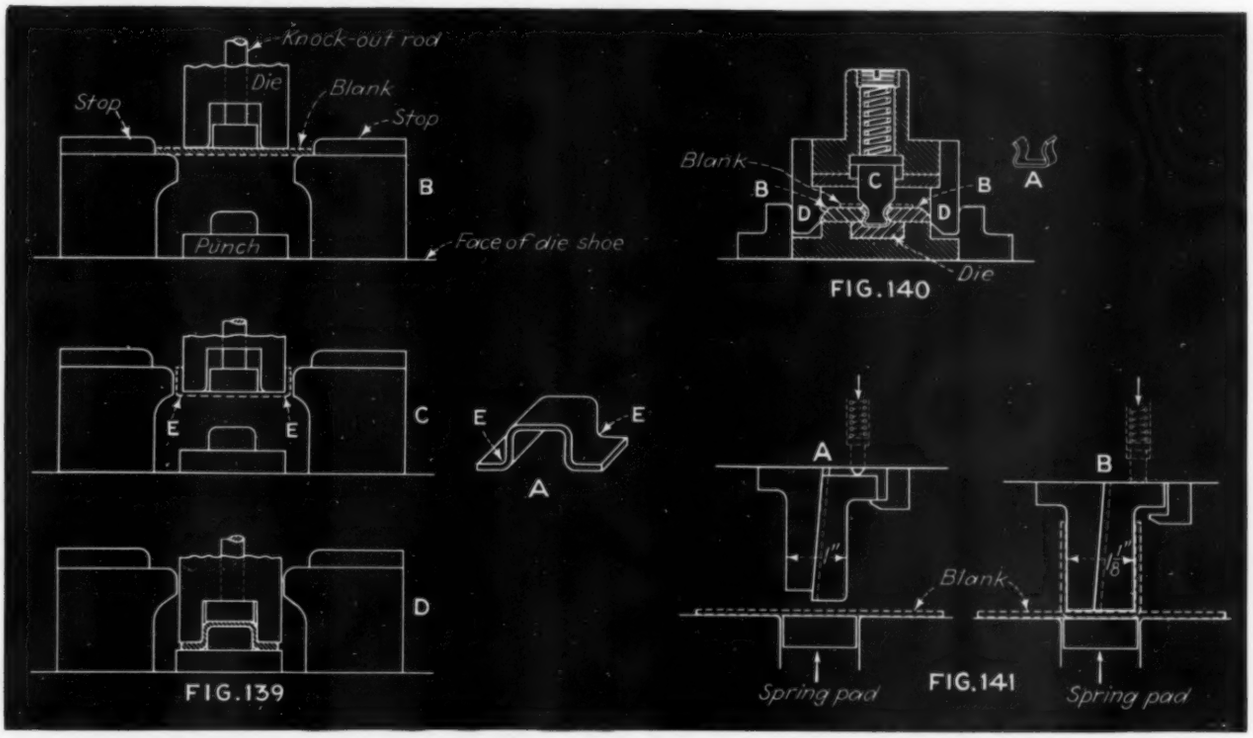


Fig. 139—This forming die principle is often overlooked, and two dies and two operations are used instead. Fig. 140—A blank resting on the slides B—B *is pushed down between them to form a U shape, and the slides then advance to form to form the sides of the part. Fig. 141—On the upstroke, the punch collapses and the part is left standing on the spring pad*

too low, stop block *G* prevents injury to the rod and die.

A cutting-off and bending-die for forming a bracket in one operation is shown in Fig. 138. The bracket is formed over the positive punch *B*, when the positively attached forming die *F* descends and cuts off the strap stock at both ends, between blocks *A* and *E*. The work is advanced under the positive channel plate *C*, and stops against pin *D*, where ¼ in. waste is cut from the strip to obtain the rounded corners on the work. The surfaces of *A*, *B* and *E* are in a horizontal plane.

When member *F* cuts the strip to length, and bends the free ends of the blank down over punch *B*, it banks on the work at the completion of the press stroke, and spanks the angles square. Four inserted pins *I* guide the blank straight while forming. Upon ascent, the die carries up the work, which is ejected by pad *G*. Punches can be arranged to pierce holes in the work, through die block *A*.

Fig 139 illustrates the method for *D*—*D* contact and start moving in the slides, the work is thrown up U-shaped between the noses of slides *B*—*B*. The punch then carries the U-shaped work down on the face of the die. The ram, continuing in descent, compresses the spring above the punch, and simultaneously forces the side punches *D*—*D* to advance the side-forming cams inward. At the bottom of the press stroke, as shown, the bottom and sides of the work are spanked to size. At the top of the press stroke, the formed piece

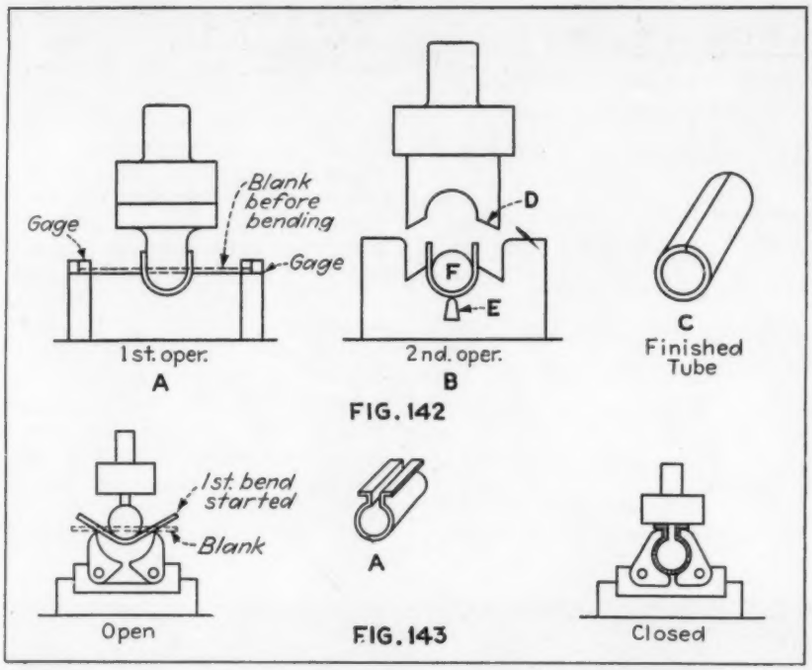


FIG. 142

FIG. 143

Fig. 142—A marking punch E *scores the tube to relieve spring back and cause the ends to close tightly. Fig. 143—Swinging die members avoid necessity for two operations to form the piece*

is pushed from the punch with a hand tool.

A collapsible punch is a convenience when forming and stripping deep bends, as shown in Fig. 141 at *B*. The punch is shown collapsed at *A*, but when the punch descends on the blank, over the spring pad, it is forced to expand full width, as seen at *B*. The ends of the blank are thrown up by further punch descent. On the up-stroke the punch collapses as it leaves the work and the finished piece is left standing on the pad.

One method for forming a circular tube in two operations is shown in Fig. 142. In the first operation at *A*, the blank is located between gages. When the punch descends, the blank is bent U-shaped. In the second operation at *B*, the tube is completed as shown at *C*.

In the second operation, the angular faces *D* on the punch contact the free ends of the U and close them in. Thus, the ends readily enter the punch opening. An inserted marking cutter *E* relieves the spring strain in forming, and causes the ends to form tight together. Arbor *F* is removed after forming the finished tube shown at *C*.

There are several objections to forming a tube in this manner, especially if precision work is expected. If the marker is discarded, because it scores the tube, it will be found that the ends will not close together tight. There will be a gap of 0.005–0.015 in. between the ends, because of spring-back.

Another fault is that the tube may twist in forming; thus, the ends of the tube will not have flush surfaces. A remedy for both these faults is to force the finished tube through a sizing ring with a shouldered punch, the arbor of which extends through the tubular hole. The hole through the sizing ring is slightly tapered inward toward its delivery end, the same as is used in a burnishing die.

In this type of sizing die, the tube is forced through a sizing ring, or bushing, horizontally. The horizontal punch is reciprocated by a side cam attached to the punch-holder, and the pieces roll into the die from an inclined magazine. They are stopped in front of the punch ready for insertion through the die. The sizing ring floats in a holder, and has about 0.010 in. floating clearance. It aligns itself instantly when the work, on the punch, enters it.

Fig. 143 represents a bending and forming principle for producing in one operation the piece shown at *A*. This operation is usually done in two or more dies. There are other ways to produce this piece; for example, it could be formed in a die similar in design to the one shown in Fig. 140.

Part 23 of Mr. Hinman's series will appear in an early number.

Product Design Versus Tool Design

By ROBERT S. ALEXANDER

I was interested in the article by Knox A. Powell, under the above title (*AM*—Vol. 83, page 20). Briefly it was an interesting plea for closer cooperation between the production tool engineers.

A few years ago I had a concrete illustration of this in a small plant which had contracted to build a number of envelope addressing machines. A young engineer had designed the support shown in Fig. 1 for a sheet-metal chute to receive the envelopes after being addressed, and through which they were to slide by gravity into a container. The support was to be made from round bar stock, and was to have a planed surface at an angle that was, from the shaper operator's point of view, almost prohibitive. After a discussion with the shaper operator, the simpler and cheaper support shown in Fig. 2 was designed. It was made from a piece of strap iron, bent as shown, and welded to the underside of the chute, making a satisfactory support. This change in design eliminated two awkward tapped holes and a difficult machining operation.

In addition to the changed design, several short cuts were evolved because of the close cooperation between the design and production departments, which adds point to Mr. Powell's contention that "A little insight into the other fellow's job would avoid a lot of trouble."

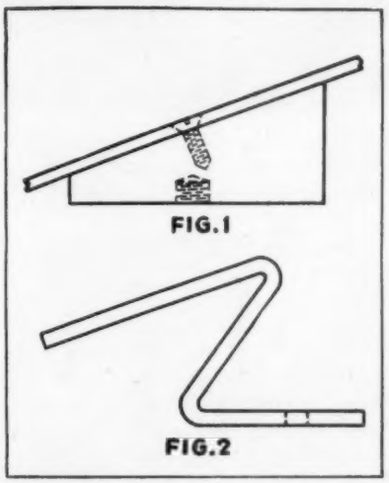


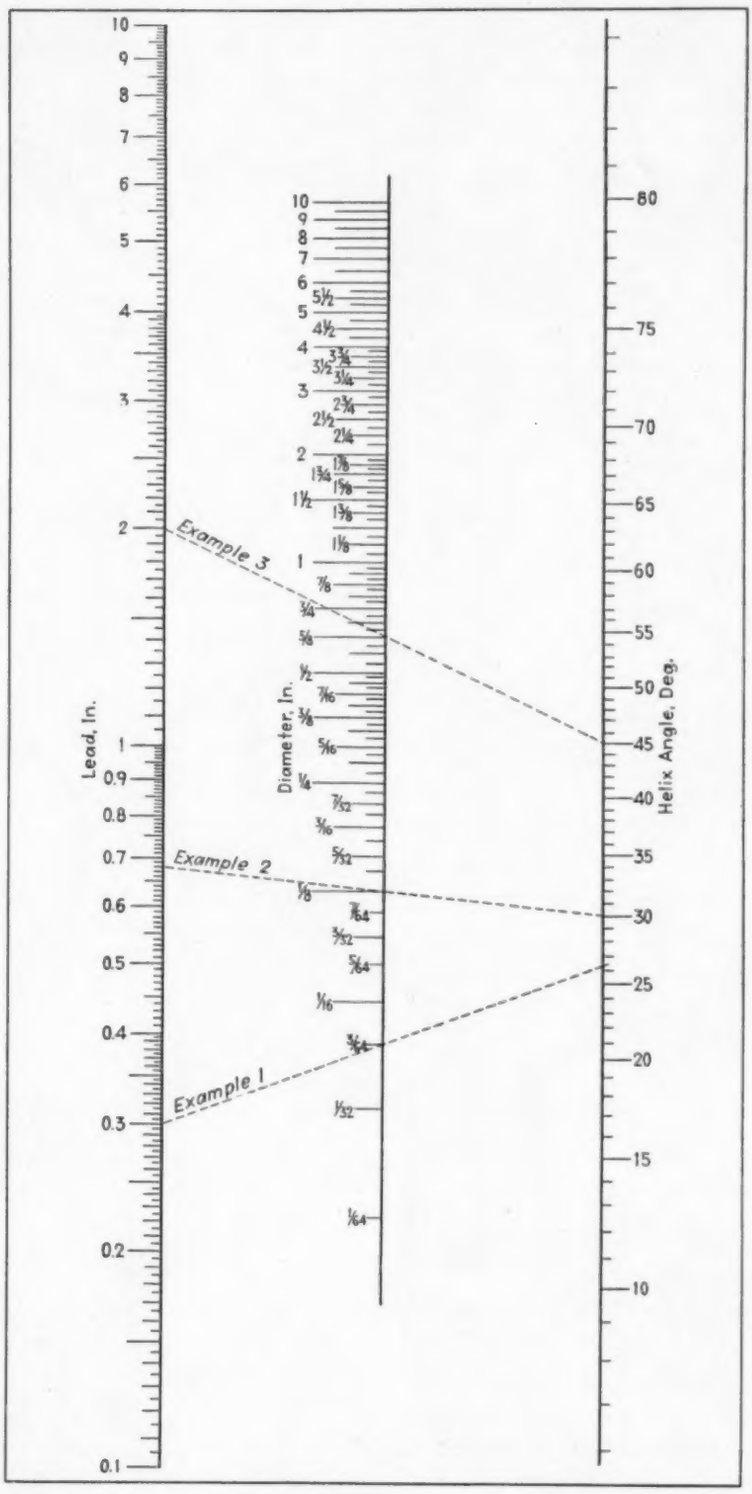
FIG. 1

FIG. 2

Two designs of a support for an envelope chute. Difficult machining was avoided by adopting the design shown in Fig. 2

Drill and Reamer Dimensions

A graphic method of determining the lead, diameter and helix angles of drills and reamers



INSTRUCTIONS FOR USE OF THE CHART

This chart can be used to find the lead, diameter or helix angle of a drill or reamer when two of these three values are known. When a straight line is drawn through the values of the two known quantities, it will intersect the value of the unknown quantity.

Example No. 1: Given a lead of 0.300 in. and a diameter of $\frac{3}{16}$ in. to find the helix angle. When a line is drawn through the given lead and diameter, the helix angle is found to be 26 deg. 9 min.

Example No. 2: Given a helix angle of 30 deg. and a diameter of $\frac{1}{8}$ in. to find the lead. When a line is drawn through the given helix angle and diameter, the lead is found to be 0.680 in.

Example No. 3: Given a helix angle of 45 deg. and a lead of 2 in. to find the diameter. When a line is drawn through the given helix angle and lead, the diameter is found to be $\frac{5}{8}$ in.

$$\text{Tangent helix angle} = \frac{\text{Circumference}}{\text{Lead}} = \frac{\pi \times \text{diameter}}{\text{Lead}}$$

Courtesy of The Cleveland Twist Drill Company.

IDEAS FROM PRACTICAL MEN

Drilling and Tapping Locomotive Boilers

By CHARLES LAMB

In attaching devices to locomotive boilers, the holes for the studs must be drilled and tapped parallel with each other and equidistant from a radial line through the boiler. The holes are generally drilled and tapped by tools held in either a pneumatic or an electric portable drill, the drill being held by the usual chain around the boiler and tightened by either a ratchet and pawl or a turnbuckle.

To facilitate correct alignment of the drill or tap, the gage illustrated in Fig. 1 was made. It is in two parts cut from $\frac{1}{8}$-in. boiler plate to the dimensions given in Fig. 2. The feet are twisted to an angle of 90 deg. so that it will rest evenly on the boiler. The two parts are riveted together to make a joint so that the pointer will be free to turn on the axis formed by the rivet. As shown in Fig. 1, the gage is set for aligning the drill for drilling one of two stud holes on 8-in. centers. What the gage really does is to check the setting of the drill or tap to the correct angle to the curvature of the boiler shell so that the studs will be parallel with each other when pulled into the tapped holes.

Before riveting the two parts of the gage together the body should be graduated, the graduations denoting the center distance of the holes to be drilled and tapped for the studs. A study of Fig. 1 will show how the position of the graduations and their spacings were obtained.

Since line *A-B* drawn through the center of the gage body is at a right angle to the radius *C-D* drawn through the point where the center of the drill touches the boiler, and line *F-H* drawn through the center of the pointer is at a right angle to the axes of the stud holes and also at a right angle to the radius *K-L*, angle *X* formed by radii *C-D* and *K-L* is equal to angle *Y* formed by center lines *F-H* and *A-B*. Dividing one-half the center distance of the stud holes by the radius of the boiler gives the sine of angle *X*, the corresponding angle of which is to be found in a table of sines. Angle *Y* is laid off on the body of the gage from center line *A-B* and an arc is struck from the rivet hole as a center. The arc is divided into eight equal parts between lines *F-H* and *A-B* and into a like number of parts above line *F-H*, sixteen in all.

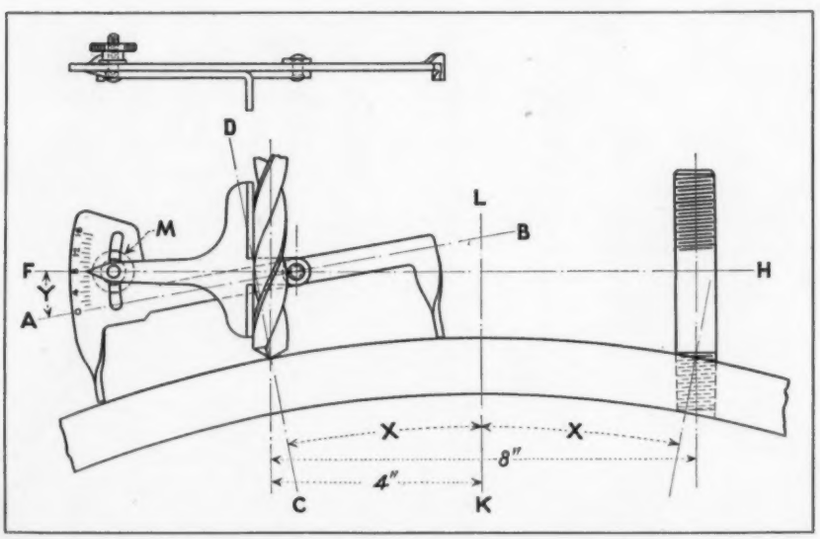


Fig. 1. With the pointer set to the number corresponding to the center distance of studs, drill can be aligned so studs will be parallel when set

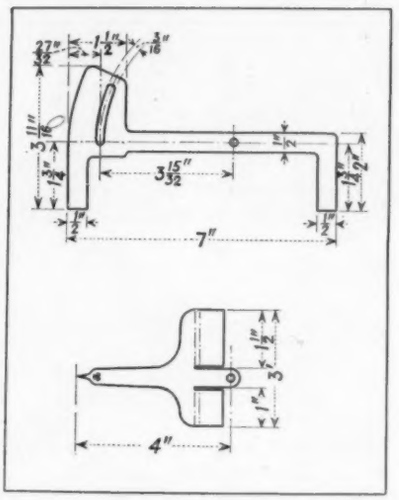


Fig. 2. Both parts of the gage are cut from $\frac{1}{8}$-in. boiler plate to the dimensions given and are riveted together to make a pivoted joint

Alternate divisions are stamped in even numbers.

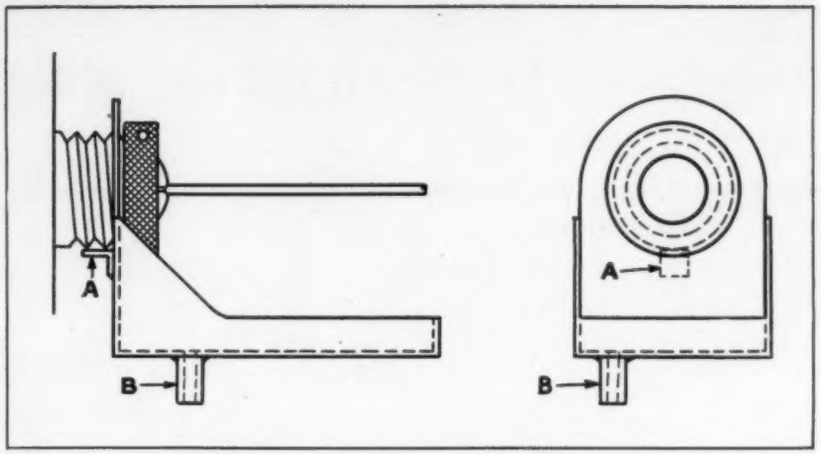
The location of the stud holes is laid out and center punched. The pointer is set to division 8 to align the drill for drilling one of two stud holes on 8-in. centers and is clamped by the knurled nut *M*. The gage is then placed on the boiler in the position shown and the drill is aligned by it.

Because the center distance of the stud holes is so small compared with the diameter of the boiler, the gage can be used on boilers that vary several inches in diameter. Although the gage is shown checking the alignment of a drill in the vertical position, it can be used to check the alignment of a drill at any angle between the vertical and the horizontal.

Catch Pan for Oil or Coolant

By C. W. ANDERSON

To prevent the oil or coolant used on the work from flowing over the table of a universal milling machine, I devised the catch pan illustrated. One end of the pan is hooked over the nose of the spindle in the di-



The coolant is directed into one of the T-slots of the machine table by a short piece of copper tubing soldered to the bottom of the pan.

viding head and the bracket *A*, soldered to the end of the pan, bears against the under part of the spindle nose and prevents the pan from sagging. A short piece of copper tubing *B* is soldered to the bottom of the pan directly over one of the T-slots in the machine table so that the T-slot conveys the oil or coolant back to the well and its constant flow is kept up by the pump.

Press Tools for Punching on the Rise of a Curve

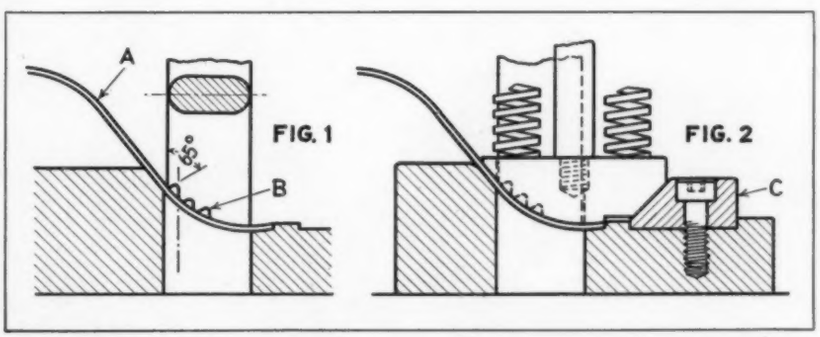
By WALTER WELLS

The illustration shows a set of press tools that solved an annoying problem after some modifying features were added to their original construction.

Referring to Fig. 1, some large panels *A* had formed flares along their sides and each had to have an oblong hole punched in it. The location of the hole was wholly on the rise of the curve and tended to deflect the punch and to cause the stock to slip. Furthermore, when the tools lost the least bit of their keenness, the obtuse angle (140 deg.) at the left-hand side of the die opening caused a tearing, ironing effect, leaving a large burr that was not permissible.

To obviate these conditions, three flutes *B* were milled in the punch face. The crown of the outer flute has a keen edge at an acute angle which reduces punching resistance and tends to keep the left-hand side of the punch in close contact with the adjacent side of the die opening. The crowns of the other flutes are slightly rounded and the remainder of the punch face follows the curvature of the die. All three of the flutes give a directional shearing cut. It will be noted that shearing action takes place only during the initial penetration of the stock. Once the stock has been penetrated there is sufficient pilot effect to complete the punching.

An important feature contributing to rigidity of action is the simultaneous contact of the three crowns of the flutes and the heel of the punch with the die. The cut at the punch heel is practically straight and the stock gets needed support from the die, due to friction during punch-stock-die impact.



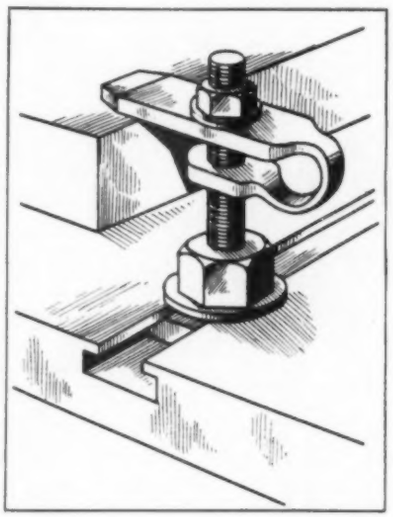
Punch deflection and stock slip were eliminated by a study of shear profile, plus the use of a combination hold-down, stripper and compensator

Since a spring-actuated stripper was necessary, again the oblique match-up caused difficulty by an insecure, bouncing pressure during operation. To remedy that condition the compensator *C* (Fig. 2) was added. The 45-deg. angle of contact of the stripper with the compensator holds the stock positively in position, the powerful springs of the combination stripper and hold-down getting in their full effect. So it will be seen that the various features of the tools all cooperate to equalize cutting action and to keep the stock under control.

Combined Clamp and Heel

By CHARLES H. WILLEY
Superintendent of Manufacturing, Hoyt Electrical Instrument Works

For clamping work to either the machine table or to the faceplate of the lathe, the combined clamp and heel illustrated is a very convenient device. It will always stay in place, even when completely released from the work, and will not flop around



The clamp can be used with a stud or bolt of any length to suit the work. It is particularly adapted to faceplate work

when the operator is setting up a job. The clamp can be used on studs or bolts of any length to suit the work to be clamped. Combined with the ease of movement of the stud or bolt in the T-slot of the machine table or in a slot in the faceplate of the lathe and an extra nut to hold it in place, it makes a rapid working tool for repetitive work.

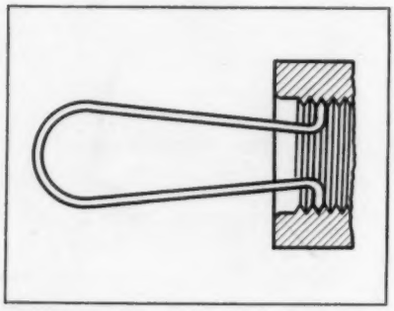
The clamp is thinned near the middle and is bent into a U-shape, as

shown. The lower member is tapped for the stud or bolt and the hole in the upper member is for clearance.

Cleaner for Internal Threads

By JOSEF N. PETERSON

A piece of $\frac{1}{4}$ or $\frac{5}{16}$ in. round brass rod bent into U-shape and having the ends bent outward and filed to fit the threads, as shown in the



This little device is very convenient for cleaning dirt and chips from the threads of chucks and faceplates

sketch, makes an ideal device for cleaning internal threads.

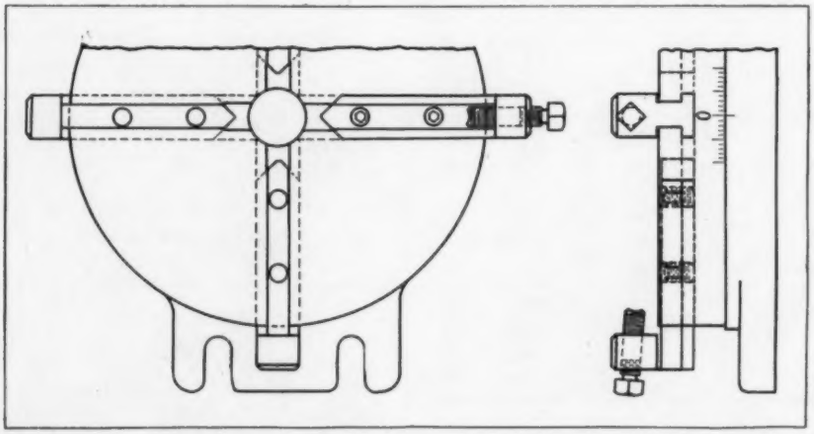
The top and bottom faces of the V-s are filed flat so that the edges will easily pick up and remove all chips and dirt as the tool is revolved. The U-shape of the rod gives just the right tension and, being brass, there is no danger of its scraper ends marring the threads in any way.

Extension Clamps for a Circular Table

By JOHN W. GERDEL

We had to make a lot of molds for casting aluminum sheaves of from 8 to 20 in. in diameter. For milling the recesses for the arms the smaller molds were held on the circular table of our vertical milling machine by ordinary strap clamps, but the larger molds covered the table and left no room for clamps, so that clamping by ordinary means was not possible.

This difficulty was overcome by making a set of extension clamps out of cold-rolled steel to fit the T-slots of the table, converting it into an independent chuck, as shown in the illustration. Both the bodies and the outer ends of the clamps were drilled and tapped for $\frac{3}{8}$-in. screws. Headless screws in the bodies of the clamps bore against the bottoms of the T-slots when tightened and held the clamps securely in any desired position. Cup-pointed setscrews in the outer ends of the clamps were at such an angle that as they were tightened on the work they also pulled it down on the table.



The clamps converted the table into an independent chuck. Tightening the clamping screws not only held the work but pulled it down on the table

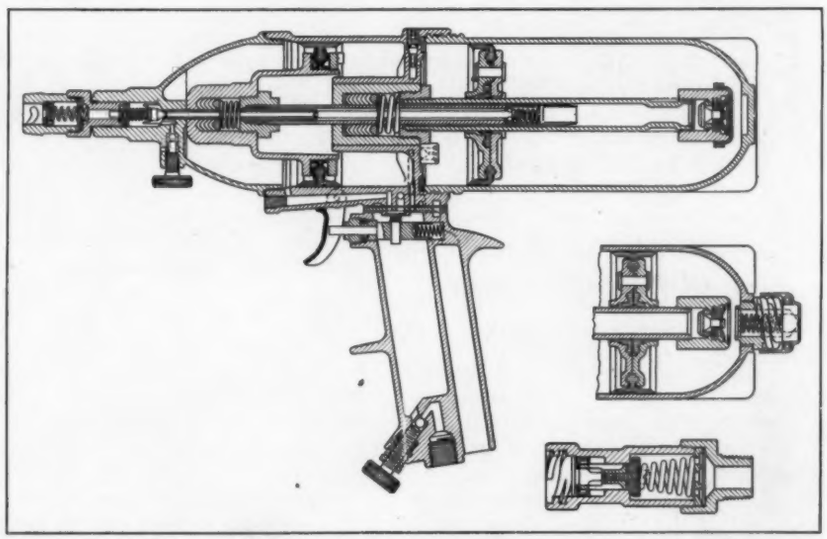
Making Sectional Models

By N. V. SMITH

President, Smith-Johnson Corporation

Any shop man who has had a casual request from the sales department to make a sectional model of an appliance for use in advertising or for display purposes realizes what a headache the job is likely to be, especially if it has movable parts that must be operated in demonstrating. One of our shop force hit on a novel way of making such models.

In the illustration is shown a sectional model of one of our lubricators. It was completely assembled and large holes were drilled in one half of the case, through which was poured an alloy having a melting



Sectional model in which the movable parts were anchored by filling the cavities with an alloy having a low melting point

point below that of boiling water, the cavities having first been filled with hot water. After the alloy had solidified, a slabbing cut followed by a finishing cut was taken in the milling machine, finishing all details to the same plane, since they were rigidly held in position by the alloy used for anchoring them. It was then necessary only to warm the model to remove the alloy.

In our case the model was cut away just short of the center line so that all the movable parts remained in place. All operating or adjusting screws that were partly cut away and were needed for demonstration were removed and whole screws were put in their places.

The Processing of PLASTICS

THOUGH the term *plastic* means *capable of being molded*, a large proportion of plastics are not molded. Precise figures are lacking, but probably about half of the total value of the plastics produced involve machining rather than molding operations. Nearly all types are available in sheets, rods and tubes. Others can be had in the form of castings. The molded form is employed only when it has an economic advantage over other forms, much as the die casting is used in metal-working where die cost can be justified.

Plastics take the place of metals in some applications, but in a large majority they are supplementary. Their properties are so different from metals that, though often used in combination, each performs some function which the other cannot—a natural supplementary function. Many of the more important forms can be worked by machines already installed in metal-working shops, including lathes, millers and drill presses.

Aside from the numerous *types*, many plastics come in various forms paralleling those available in metal. Sheets, for example, can be secured in thicknesses ranging from a few thousandths of an inch upward to ½ in. or more. Slabs can be bought up to 4 in. or more in thickness. Rods come in sizes of ⅛ in. or smaller up to 2 in. or more. Some extruded shapes are available and bars of almost any contour can be cast. Tubes come in a great variety of diameters and wall thicknesses, some of them in odd shapes. Castings are more limited in shapes available than in metal, but many are made, some being of large size and with irregular surfaces.

Materials for molding come, as a rule, in powdered or granular form packed in drums and should be stored, when storage is necessary, in cool dry rooms. Some materials deteriorate in prolonged storage. Many materials are suitable for preforming (pilling) and often are used to advantage in this form.

With possible minor exceptions, all cast plastics are sold in cast form, as the process of casting (not to be confused with molding) requires, as a rule, special equipment, including special ovens for curing the castings. Laminated plastics, which come in sheets, rods, tubes and slabs, constitute a special class of plastics of great importance and are furnished ready for use by laminators having special pressing equipment.

TYPES AVAILABLE

About a dozen general types of synthetic plastics are commercially available and in extensive use, as shown in an accompanying table. Many other types have been made in at least experimental quantities but have yet to gain extensive use. Natural materials, such as rubber and shellac also are used in making particular types of plastic. In many cases, the plastic itself is not used in its pure form, but is mixed with a filler to lower cost, increase strength or provide properties which the plastic lacks. In such cases the plastic acts as a binder and imparts many of its properties to the composite material.

A majority of plastics are softened by heat, especially for molding and sometimes for other operations, and become hard when they cool. If they can be softened again by heating, they are called *thermoplastics*, but if they become permanently hard they are called *thermosetting* plastics. Phenolic and urea plastics are the most important thermosetting types, but the protein plastics and some cold-molded forms become permanently hard. Other forms of importance are thermoplastic and must, as a rule, be confined to uses in which the temperature remains below that at which significant softening occurs.

Although the cast phenolic plastics are thermosetting when fully cured, they often are made available in forms not fully cured. In this form they can be softened temporarily by heating to facilitate working, such as bending and cutting, but the process of heating results in further curing and cannot be repeated indefinitely, as it can with thermoplastics.

Due credit is given the following organizations for data supplied by them toward the preparation of this section:

American Hard Rubber Company
Bakelite Corporation
Beetle Products Division, American Cyanamid Company
Boonton Molding Company
Brown & Sharpe Manufacturing Company
Carbide & Carbon Chemicals Corp.
Carboloy Company
Catalin Corporation
Chicago Molded Products Corp.
Cleveland Twist Drill Company
Continental Diamond Fibre Company
Dow Chemical Company
E. I. du Pont de Nemours & Company
General Electric Company
General Plastics, Inc.
Greenfield Tap & Die Corporation
Haynes Stellite Company
Hercules Powder Company
Monsanto Chemical Company
Morse Twist Drill & Machine Company
National Twist Drill & Tool Company
National Vulcanized Fibre Company
Ortho Plastic Novelties, Inc.
Plaskon Company
Synthane Corporation
Tennessee Eastman Corporation
Westinghouse Electric & Mfg. Company

WHAT PLASTICS TO USE

Selection of a plastic can be facilitated by checking against the accompanying tables. Highly important are such factors as: method of fabrication to be used, color and general appearance required, resistance to heat and to exposures encountered in service, strength, toughness, hardness, insulating properties, weight and cost.

METHOD OF FABRICATION

This depends largely upon the character of the part and the quantity required. If the part necessarily is complex in shape or of such form that molding is clearly desirable, molding naturally is the first method of fabrication to consider; but in this case, mold cost and molding rates require attention. It is not often feasible to absorb mold costs when total requirements are below 1,000 to 5,000 pieces, but there are exceptions, especially for small molds.

On the other hand, several types of plastic can be fabricated by stamping, screw machine operations and similar rapid production methods which may offset the higher material cost. In some cases this results in products superior to those fabricated by molding. In addition, where no mold is needed, tool costs usually are quite low, although for stamping tool cost may be no lower than for molding.

COLOR AND APPEARANCE

Color and appearance often are factors which determine the selection of plastics. Where black or dark colors, which are not translucent or transparent, are satisfactory and molding is the method of fabrication, phenolics, rubber, cold-molded or certain protein plastics are often chosen because they are low in cost and generally satisfactory otherwise. Some plastics, including certain light-colored phenolics and rubber, fade or discolor in sunlight and hard rubber loses its luster. Where white or light tints are needed and translucency is desirable, molded ureas often are chosen. They are low in price as compared with most plastics, but higher in price than phenolics. Color and translucency which characterize ureas are obtainable also in the thermoplastics.

Several makes of laminated sheet now are available in light colors which are translucent, and all makes come in black and dark colors. The cast phenolics also come in light translucent and transparent tints, but not all of these are light fast. Casein plastics come in white and light tints, often translucent, and have the advantage of taking certain forms of dye. The remaining plastics, which include most of the thermoplastics, can be had in almost any color.

Cast phenolics come in the same forms and colors as other plastics, as well as in some mottled effects not commonly available in the others. Acrylic and polystyrene plastics in their pure forms have remarkable clarity and often take the place of glass, even for some lenses.

HEAT AND EXPOSURE

Resistance to heat and to exposure can be determined in part by reference to the accompanying table of physical characteristics in which the maximum safe operating temperatures are set down. The temperatures are "safe" in the sense that the plastic does not ordinarily decompose or seriously deteriorate, at least not for short exposures, at these temperatures.

PHYSICAL CHARACTERISTICS OF TYPICAL PLASTIC MATERIALS

Type of Material	Tensile Strength — (100 lb. per sq. in.)	Compressive Strength — (100 lb. per sq. in.)	Impact Strength — Foot-Pounds (½ x ½ in. specimen) (See Notes)	Bending Strength — (100 lb. per sq. in.)	Specific Gravity	Brinell Hardness — (Except as noted)	Maximum Safe Operating Temp. (S) — (Deg. F.)	Water Absorption — (Per Cent)	Rate of Burning	Dielectric Strength — (Volts per Mil.)	Cold Flow	Machining Properties	Compression Molding Temperature — (Deg. F.)	Compression Molding Pressure — (100 lb. per sq. in.)
Pyroxylin	60-90	—	0.25-1.0 (A)	—	1.35-1.60	10-20 (F)	140	1.3-2.6 (P)	High	600-1200	Slight	Excellent	185-250	1-5
Cellulose Acetate	30-90	110-273	0.4-1.8 (A)	52-162	1.26-1.60	6-12.2(F)	140-180	1.0-5.0 (P)	Low	600-1800	Slight	Good	250-350	1-50
Protein (including Casein)	76	—	1.0 (B)	—	1.35	23 (H)	—	3.0-7.0 (P)	Low	400-700	—	Good	240-300	20-25
Vinyl	60-100	—	0.3-0.7 (D)	100-130	1.30-2.50	10-25 (I)	—	0.05-0.70 (P)	Non-Flam.	350-500	Slight	Good	240-300	15-20
Urea (Amino)	40-130	205-350	1.05-1.40 (A)	70-160	1.46-1.50	48-54 (N)	160-170	1.0-2.0 (P)	Very Low	365-700	Nil	Fair	280-320	20-80
Phenolic, Molded — Wood Flour Filled	50-100	250-360	0.65-0.75 (A) 0.12-0.16 (B)	90-200	1.33-1.52	30-45 (H)	300	0.2-0.8 (P)	Very Low	300-500	Nil	Fair	280-360	16-45
Phenolic, Molded — Mineral Filled	50-100	180-360	0.4 (A)	80-200	1.80-2.00	—	—	0.01-0.3 (P)	Nil	200-400	Nil	Fair	270-350	16-60
Phenolic, Cast	30-120	100-300	0.2-0.48 (A) 1.1-1.5 (B)	70-120	1.27-1.335	—	160	0.01-0.7 (P)	Nil	250-450	Nil	Excellent	—	—
Phenolic, Laminated — Paper Base	190	180-350	0.4-0.7 (B)	150-250	1.36	34-40 (H)	225-250	1.0-5.0 (P)	Very Low	250-1000	Nil	Good	—	—
Phenolic, Laminated — Fabric Base	80-100	210-400	2.0-6.5 (B)	150-200	1.38	30-45 (H)	225-250	0.5-3.0 (P)	Very Low	150-500	Nil	Fair to Excellent	—	—
Cold Molded — Non-Refractory	7-25	30-130	0.4 (C)	53-75	1.90-2.50	24-40 (H)	400-600	0.5-3.0 (R)	Nil	50-100	—	Poor	Room	40-120
Cold Molded — Refractory	12-15	150-180	0.4 (C)	60	2.00-2.50	30-45 (H)	1500	0.5-12.0 (R)	Nil	40-100	—	Nil	Room	40-120
Rubber-Like	2-50	85-110	2.6-6.2 (D)	70-90	1.06-3.00	55-84 (L)	140	0.02-0.3 (P)	Low	515-860	High	Poor to Good	200-300	12-50
Acrylic	90-120	80	0.2-0.3 (A) 0.1-0.13 (D)	120-140	1.18-1.20	18-20 (K)	140-190	0.3 (P)	Low	480	Slight	Fair	285-315	15-50
Hard Rubber	40-90	100-120	0.5 (B)	90-150	1.15-1.25	31 (H) 40-70 (L) 90-93 (M) 83-85 (L)	130	0-0.2 (P)	Medium	1000-1500	Slight	Good	285-350	12-18
Styrene	55-70	—	0.2-0.3 (B)	70	1.05-1.07	60-80 (M)	172-176	0 (P)	Low	2200-5500	Medium	Good	280-350	3-30
Ethyl Cellulose	70-85	100-120	2.0-5.0 (B)	90-100	1.10-1.25	60-80 (M)	130-150	1.25 (R)	Low	1500	Slight	Excellent	320-360	10-50

Notes on impact strength: (A) Charpy, notched bar; (B) Izod; (C) Charpy, unnotched; (D) Izod, notched. Hardness notes: (F) 10 kg. load on 2.5 mm. ball; (H) 25 kg. load on 2.5 mm. ball; (I) 550 lb. load for 3 min.; (K) 500 kg. load on 10 mm. ball; (L) Shore scleroscope; (M) Rockwell, 60 kg. load on ½ in. ball; (N) 50 kg. load on 10 mm. ball. Notes on operating temperatures: (S) "Safe" for short exposures, and in some cases for continuous exposure, but some softening may occur with thermoplastics. Notes on water absorption: (P) Per cent in 24 hours; (R) Per cent in 48 hours.

PLASTIC MATERIAL	Toughness (Impact Strength)	Flexural Strength	Tensile Strength	Color	Cold Flow	Water Resistance	Acid Resistance	Caustic Resistance	Solvent Resistance	Dimensional Change on Aging	Heat Resistance	Flammability	Heat Insulation (Thermal Conductivity)	Weight per Unit Volume (Specific Gr.)	Hardness	Loss Factor (Range of Frequencies)	Resistivity	Dielectric Strength	Moldability Around Inserts
Phenolic: General Purpose	⑥	③	②	③	④	⑤	③	③	①	④	②	③	③	③	⑤	⑤	⑥	④	①
Phenolic: Low-Loss	③	③	③	③	②	②	③	③	①	②	③	①	⑥	⑥	②	②	②	③	①
Phenolic: Heat-Resistant	⑦	④	⑦	③	①	②	④	③	①	①	①	①	⑥	⑦	①	○	⑦	⑤	①
Phenolic: Acid & Alkali Resistant	⑧	⑤	⑤	③	⑥	③	②	②	①	⑤	③	②	②	②	④	○	③	④	②
Phenolic: Shock-Resistant	②	②	④	③	⑤	⑥	④	④	①	⑥	③	④	②	④	⑤	○	⑧	⑤	①
Urea	⑤	①	①	①	③	④	④	③	①	⑦	⑥	⑤	⑤	⑤	③	④	④	①	③
Polystyrene	④	⑤	⑥	②	⑦	①	①	①	②	③	④	⑥	①	①	⑥	①	①	②	⑤
Cellulose-Acetate	①	⑤	④	②	⑧	⑦	④	④	③	⑧	⑤	⑥	④	③	⑦	③	⑤	④	④

This table indicates the comparative order of merit of plastics furnished by the Bakelite Corporation and now in extensive use. The order would be changed, of course, if the table included all types of plastics

Warpage, slight softening and possible other changes may occur in some instances at the maximum "safe" temperature given. The thermosetting plastics do not soften when heated, but they may warp, especially if the temperature varies throughout the piece; and if the temperature be raised much above the "safe" point discoloration or even charring may result. If the "safe" temperature be exceeded with thermoplastics, softening occurs and the piece may sag even under its own weight. Thermoplastics are subject to some cold flow (permanent set under load) at ordinary room temperatures and this tendency increases as temperatures are raised. Dimensional changes sometimes occur with heating, and even without heating in other cases. Some plastics become quite brittle at abnormally low temperatures.

Other unusual exposures besides those of heat have such different effects on different plastics that general statements are of little value. Nearly all absorb moisture which affects certain properties. Only a few are recommended for outdoor exposure. Some are inflammable, others not. Certain grades are suited for certain special types of exposure. It is best to consult plastic makers before selecting any plastic to perform under any out of the ordinary conditions.

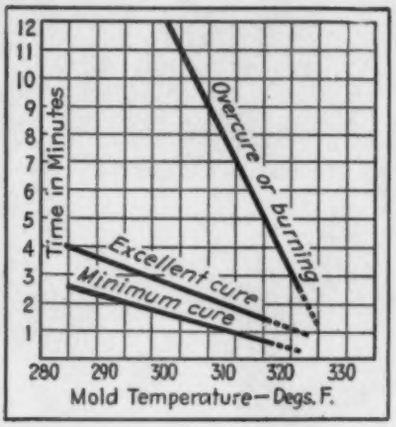
STRENGTH

Strength, toughness and hardness are best compared by reference to the tables given. In these and in other properties, however, it should be noted that a range of values is given, as there usually is a choice of several materials by different makers and different grades of the same make are to be had. In some cases, values outside those given in the table doubtless can be obtained. Some help in the selection can be had by reference to the accompanying chart compiled by the Bakelite Corporation and which, it should be noted, refers only to phenolic, urea, polystyrene and cellulose acetate plastics.

ELECTRICAL RESISTANCE

Insulating properties are given in the form of dielectric strength in the table of physical properties and relatively under loss factor and resistivity, for eight general types of plastic, in the table on this page. The latter also gives relative heat conductivity. As plastics are employed extensively as dielectrics, many rather special grades have been developed for special dielectric uses, such as low-loss plastics for radio applications and other high-frequency purposes. This is true not only for molding plastics, but in even greater degree in the laminated types.

This chart indicates the curing rate of Plaskon "standard medium" urea compounds in sections 0.070 in. thick. This chart applies also to "hard grades" but soft grades require a longer cure. Add ½ min. for each ⅛ in. increase in section thickness



WEIGHT AND COST

Weight and cost are inter-related since plastics are sold, as a rule, by the pound. Specific gravity is given in the table of physical properties and in some plastics is found to embrace quite a range of values. This is chiefly because fillers of widely different weights are employed, and the proportion of filler to binder varies. Naturally, there is more volume in a pound of low-gravity plastic than in a pound of one having a higher gravity, and this should be considered in making cost comparisons. When it comes to sheets, rods, tubes, slabs and special castings, the price per pound varies widely, depending partly on thickness, in the case of sheets, and on size and wall thickness for tubes.

METHODS OF MOLDING

Plastic molding generally is divided into two types; compression and injection. *Compression molding* usually is done hot; but with thermoplastics, although the molding is done hot, the mold must be cooled to harden the plastic before the moldings can be removed. One form of compression molding is done cold, the moldings being removed from the mold and subsequently cured.

Injection molding consists in heating the plastic outside the mold until it is softened into a dough-like mass and then forcing the heated plastic into the mold under heavy pressure. Only thermoplastics are injection molded on an extensive scale in this country today, but a form of injection molding, sometimes referred to as *transfer molding*, is done on a limited scale with thermosetting plastics. In this type of molding, the plastic is heated in a cylinder outside, but sometimes forming a part of the mold, while a ram applies pressure. As rapidly as fluxing occurs the plastic is forced through a gate into the mold until the latter is filled. The mold is heated and curing takes place in it, after which the mold is opened and the moldings are ejected.

PLASTICS—THEIR USES

Type of Material and Forms Available	*Outstanding Characteristics*
Pyroxylin (Nitrocellulose) Sheets, rods, tubes—transparent, translucent, opaque or mottled, any color.	Tough, extremely versatile, easily worked and printed. Can be stretched hot and shrunk or molded. Highly inflammable; embrittled by sunlight. Thermoplastic.
Cellulose Acetate and Acetobutyrate Sheets, rods, tubes and molding forms, wrapping tissues. Transparent, translucent, opaque or mottled, any color.	Extremely tough and resilient, odorless, easily worked and molded, especially by injection. Affected by water. Becomes brittle when cold. Slow burning and little affected by sunlight. Thermoplastic.
Protein (including Casein) Rods, sheets and (soya) molding materials. Casein easily colored.	Easily dyed and quite readily machined in form of casein. Useful chiefly for buttons. Affected by water. Usually thermosetting.
Vinyl Sheets, rods, tubes, molding forms and rubber-like insulation. Transparent, translucent, opaque or mottled, any color.	Tough, non-flammable, odorless, tasteless. Unaffected by water and non-warping. Easily worked and molded. Easily printed. Retains toughness when cold. Thermoplastic.
Urea (Amino) Translucent or opaque, any color.	Thermosetting. Translucent and light diffusive. Colors relatively permanent. Inserts usually not recommended.
Phenolic (Molding Type) Usually opaque and dark in color; some transparent translucent and mottled forms available.	Thermosetting. Low in cost. Most widely used molding materials. Available with wide range of fillers, giving wide range of desirable properties. Non-flammable, good dielectrics and highly resistant to water and chemical attack. Easily molded. Light colors prone to fade in sun. Not subject to cold flow. Heat resistance good (some can withstand temporarily temperatures of 400° F. or higher).
Phenolic (Cast Form) Transparent, translucent or opaque in any color, plain or mottled.	Characterized by brilliant colors, some of which are prone to fade. Available in wide range of forms. Easily machined and polished. Can be bent and sliced when heated.
Laminated (chiefly Phenolic, some Urea) Usually made opaque and in dark colors, but thin sheets are made transparent or translucent and light colors are available. Large variety of colors including some with wood-grain and other figures. Sheets, rods and tubes with paper, fabric and other fillers.	Are among the strongest plastics and some forms have high shock resistance, low water absorption and high resistance to mechanical wear. Thin sections can be punched and all forms machined, though not always easily as tools dull quickly. Are non-flammable and quite resistant to heat. Have good dielectric characteristics. They are thermosetting.
Cold-Molded (non-refractory and refractory) Molding forms only. Made with asphaltic, pitch, phenolic and cement binders and asbestos filler. Opaque; mostly black, brown and gray.	High heat resistance, and some forms good in arc resistance. Molding rapid and material cost low. Colors unattractive and lack luster. Water absorption high. Strength low. Inferior as dielectrics. Requires baking subsequent to molding.
Rubber-Like Chiefly dark and opaque but some forms are light in color and can be transparent, translucent or opaque and in a wide variety of tints or mottles. Molding forms, sheet, etc.	Some forms pliable and some have resistance to oils, fuels and chemicals which attack rubber. Moldings readily made and can have undercuts not feasible in rigid plastics. Thermoplastic.
Acrylic Usually transparent, color range unlimited. Molding and cast forms and sheets, rods and tubes.	Exceptional transparency and low water absorption. Requires high molding pressures but can be injection molded. Withstands outdoor exposure. Thermoplastic.
Hard Rubber Sheets, rods, tubes and molding forms. Opaque. Usually black but can be had in some dark colors.	Excellent dielectric characteristics and highly resistant to water and many chemicals. Extremely tough, but easy to machine. Is subject to cold flow, softens and swells in contact with oil. Requires polishing. Softens when heated. Thermoplastic. Combustible.
Styrene Usually clear transparent, available for molding. Can be cast.	Exceptional dielectric and low-loss characteristics. High in clarity and water resistance. Easily molded even in thin sections.
Ethyl Cellulose Transparent, translucent or opaque. Colors unlimited. Available for molding.	Tough and easily molded and has a high softening point. Machining qualities excellent. Flammability low. Flexible, extensible, inert, light stable.

AND CHARACTERISTICS

Trade Names	*Manufacturers*	*Principal Applications*
Celluloid Cellulose Nitrate Nixonoid Pyralin	Celluloid Corp. Monsanto Chemical Co. Nixon Nitration Works E. I. du Pont de Nemours & Co.	Sheets for printing, laminating, forming; photographic film, combs, hair ornaments, costume accessories, handbags, toilet ware, pens, pencils, curtain lights, handles and other uses.
Bakelite Cellulose Acetate Cellulose Acetate Hercules Cellulose Acetate Lumarith, Protectoid Masuron Nixonite Plastacele Tenite	Bakelite Corp. Monsanto Chemical Co. Hercules Powder Co. Celluloid Corp. John W. Masury & Son Nixon Nitration Works E. I. du Pont de Nemours & Co. Tennessee Eastman Corp.	Shatter-proof glass, window lights, Cel-O-Glass, lamp shades, automotive steering wheels and accessories, watch and clock crystals, optical instruments, electrical parts, radio parts, combs, toilet ware, "non-flam" photographic film, wrapping tissue, pens, pencils, shoe heels, knobs, handles and other uses.
Ameroid Aladdinite Ronyx (Soya Bean Deriv.)	American Plastics Corp. Alladinite Co., Inc. Resinox Corp. Ford Motor Co.	Buttons, buckles, dress accessories. Soya type: molded parts for automobiles.
Alvar, Gelva Butacite Butvar and Formvar Flamenol Koroseal, Kogene Vinylite	Shawinigan Products Corp. E. I. du Pont de Nemours & Co. Monsanto Chemical Co. General Electric Co. B. F. Goodrich Co. Carbide & Carbon Chemicals Corp.	Thin sheet (uses similar to pyroxylin), dentures, phonograph records, laminated glass, wire insulation, tooth brush handles, combs.
Bakelite (urea) Beetle Plaskon Uformite	Bakelite Corp. American Cyanamid Co. Plaskon Corp. Resinous Products & Chemical Co.	Table and kitchen ware, containers, buttons, closures, cases for clocks, radio, scales, automobile accessories, toys, handles, knobs, electrical and lighting fixture parts and other molded items.
Bakelite Catalin Durez Durite Indur Haveg* Makalot Resinox Textolite (*not for molding)	Bakelite Corp. Catalin Corp. General Plastics, Inc. Durite Plastics, Inc. Reilly Tar & Chem. Corp. Haveg Corp. Makalot Corp. Monsanto Chemical Co. General Electric Co.	Electrical parts in great variety, automotive parts, closures, containers, smokers' accessories; instrument, machine and appliance parts; cases and housings, knobs, handles, buttons, hardware parts, toys and games, table and kitchen ware, displays, novelties, decorative items, chemically-resistant parts and a wide range of other molded items.
Bakelite Catalin, Prystal Cast Phenolic Joanite Marblette Phenalin	Bakelite Corp. Catalin Corp. Monsanto Chemical Co. Joanite Corp. The Marblette Corp. E. I. du Pont de Nemours & Co.	Costume accessories, including buttons, buckles and jewelry; toilet ware, containers, cases, desk accessories, automobile parts, cutlery and hardware handles and knobs, picture frames, lamps and lighting fixture parts, umbrella handles, appliance parts, panels, trays, novelties, games, radio cabinets.
Dilecto, Celoron Duraloy Formica Insurok Lamicoid Micarta Panelyte Phenol Fibre Phenolite Spauldite Synthane Textolite Ucinite	Continental-Diamond Fibre Co. Detroit Paper Products Co. Formica Insulation Co. Richardson Co. Mica Insulator Co. Westinghouse Elect. & Mfg. Co. Panelyte Corp. Taylor Fibre Co. National Vulcanized Fibre Co. Spaulding Fibre Co. Inc. Synthane Corp. General Electric Co. United-Car Fastener Corp.	Panels for architectural and other applications, doors, table, counter and sink tops, bars, gaskets, gears, bearings, industrial truck wheels, electrical parts, cases, textile mill parts, chemical plant parts, furniture parts, automotive parts, handles, trays, headgear, instrument dials and lamp shades.
Aico and Merine Textolite Ebrok Gummon, Tegic, Hemit Pyroplax, Thermoplax Okon	American Insulator Corp. General Electric Co. Richardson Co. Garfield Mfg. Co. Cutler-Hammer, Inc. American Hard Rubber Co.	Electrical and refractory parts where heat resistance is required or where weight and moisture absorption are not objectionable. Also storage battery cases.
Marbo Neoprene Plioform, Pliofilm Thiokol Hercules Chlorinated Rubber	Marbo Products Corp. E. I. du Pont de Nemours & Co. Goodyear Tire & Rubber Co. Thiokol Corp. Hercules Powder Co.	Plioform and various molded parts. Other soft, flexible moldings, gaskets, diaphragms and the like as substitutes for rubber.
Lucite Crystalite, Plexiglas	E. I. du Pont de Nemours & Co. Rohm & Haas Co., Inc.	Window lights, cowlings and other parts in which clarity and light transmission are important, reflectors and lenses, instrument parts, decorative uses.
Ace Rub-Tex _____ _____ Luzerne	American Hard Rubber Co. The Richardson Co. Jos. Stokes Rubber Co. The Vulcan Rubber Co. The Luzerne Rubber Co.	Battery jars, parts requiring chemical resistance, low-loss dielectrics, combs, sanitary goods, pipe stems and handles.
Bakelite Polystyrene Styron _____ _____	Bakelite Corp. Dow Chemical Co. Monsanto Chemical Co. Carbide & Carbon Chemicals Corp.	Low-loss dielectrics (as in radio), lenses and similar parts for light transmission or where clarity is important.
Ethocel Hercules Ethyl Cellulose	Dow Chemical Co. Hercules Powder Co.	Being quite new, has not yet gained extensive use as a plastic.

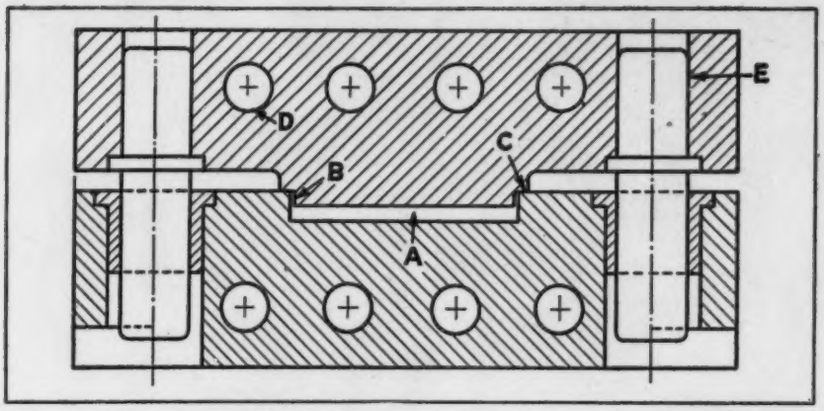


Fig. 1—Semi-positive molds, such as this, are suitable for thermosetting plastics and are especially recommended for urea plastics. The male portion of the die enters the cavity A *to apply pressure to the plastic. A vertical flash is formed in space* B, *while the land* C *forms a horizontal flash cut-off. Channels for steam heating* D *are provided in both parts of the mold and guide pins* E *are employed to maintain alignment of the mold halves*

MOLDING EQUIPMENT

Ordinary compression molding can be done in almost any press capable of applying and holding, for the necessary time, the pressure required for the particular plastic. One form or another of the hydraulic press commonly is used. Some forms are self-contained and include the necessary pumping units, but where several presses are used it is customary to connect them to a common high-pressure hydraulic system which includes an accumulator.

Heat commonly is supplied by live steam at a pressure such as to yield a molding temperature suitable for the particular plastic being used. One large modern molding plant, however, has chosen to use hot water under pressure and some plants, especially those without a supply of live steam, use electric heating units.

For thermosetting plastics, the molds remain hot, but for thermoplastics cooling by cold water is necessary after the molding is formed. Cooling lengthens the cycle, but the time can be minimized by using as little metal in the mold as conditions permit and by insulating the mold from the press platens. Cycles often are reduced by using preforms or "pills" of plastic to charge the mold.

Cold molding of refractory materials is done in hydraulic presses which are not heated, but cold molding of the non-refractory type is done in quick-acting presses, such as toggle presses resembling those used for stamping. In these, the cold charge merely is rammed into the mold, which give it its shape, and is ejected immediately. All cold moldings are laid in trays and then are transferred to curing ovens where they are baked for several hours. As cold molding requires rather special equipment for mixing the plastic in batches, which are used almost immediately, it is done, as a rule, only by a relatively small number of plants.

Injection molding commonly is done in special self-contained machines which, as far as the mold operating portions are concerned, resemble machines used for die casting metals, some such arrangement being necessary to take full advantage of the rapidity of the cycle. Thermoplastics in granular form are placed in a hopper from which they fall into a cylinder having a hydraulic ram. The cylinder is heated, as a rule, by electrical resistance or induction elements which, in turn, heat the plastic. The latter remains extremely viscous, as a rule, and in general requires the application of pressures of 12,000 to 20,000 lb. per sq. in. to force the plastic into the mold and fill the cavities completely. As the mold is cool, the pieces solidify almost immediately, hence the mold can be opened and its contents ejected within a few seconds after injection. Speeds as high as six or more fillings per minute can be obtained on small parts.

PHENOLICS

Numerous types of phenolics having different flow characteristics and physical properties are available; be sure to select the correct one. The general-purpose type, having wood flour filler, molds at 300–330 F. and 2,000–4,500 lb. per sq. in. pressure. The mineral filled type has better resistance to heat and better water resistance; some forms have low power factor. Molding temperature: 270–

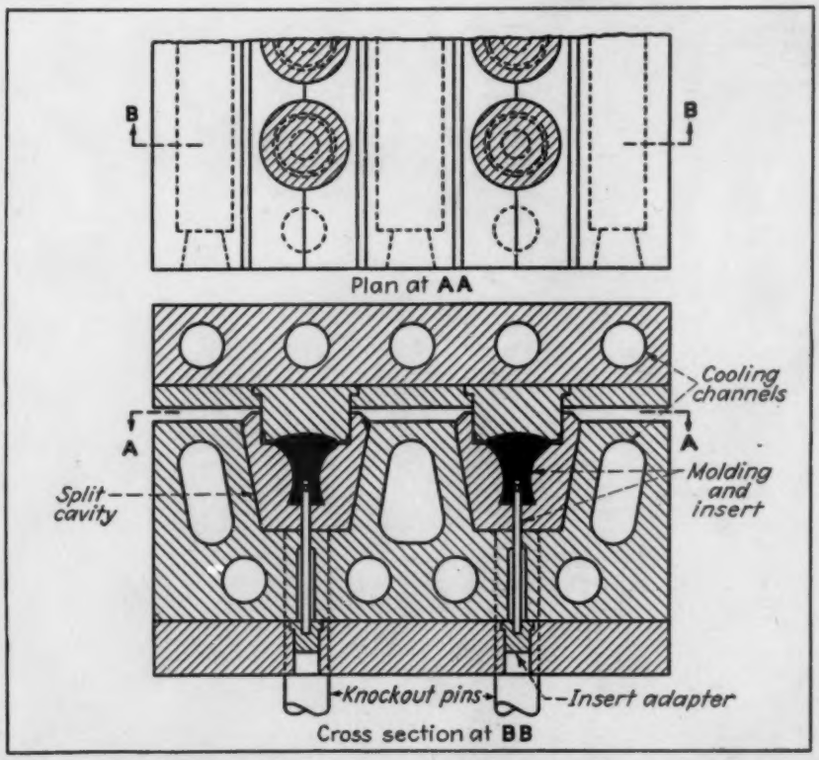


Fig. 2—Compression molds for producing small parts from thermoplastics frequently are made with multiple cavities to give the required rate of production. Cavity blocks are split in this instance to permit removal of moldings and inserts

300 F., pressure 3,500–6,000 lb. per sq. in. Most grades of the foregoing types are readily preformed. Impact-resistant types contain shredded material, are bulky and can be preformed, usually, only by hand. Molding temperature: 270–320 F.; pressure, 2,000–8,000 lb. per sq. in.

UREAS

Hard grade is stiff and cures rapidly at 300–320 F. "Standard medium" grade is widely used and is suitable for most moldings. It cures rapidly at 300–320 F. Softer grades cure more slowly at 280–300 F. but require less pressure to fill out. Curing time is important and, for "standard medium" grade of Plaskon in sections 0.070 in. thick requires the time indicated in the accompanying chart. Overcuring may result in discoloring or burning and blistering; undercuring results in lack of water resistance and sometimes in blistering.

CELLULOSE ACETATE

In general, molding cellulose acetate by compression is done with powder or granules which can be preformed, but some molding is done with slabs or sheet which may facilitate the production of a certain grain or configuration of graining. Low pressure, as from a city water main, often is used to close the mold slowly, the final fraction of an inch of closing being at high pressure such as to apply about 2,000 lb. per sq. in. on the material. The latter often is preheated. Materials are available in five or more degrees of flow. The hardest type of one make molds at 330–350 F. and the softest at 270–290 F., other grades being intermediate.

For molding *cellulose acetate* by injection, several types of material are available and each type in different hardnesses and degree of plasticity. Temperature of the mold itself usually is between 110 and 150 F. Too low a temperature may result in poor surfaces or incomplete filling of cavities. Injection cylinder temperatures run from 250–600 F., but the recommended temperature of the material (for one make) is 370–390 F. for the hardest grade and 310–330 F. for the softest grade. Injection pressures vary from 2,000–30,000 lb. per sq. in., but commonly are between 10,000 and 20,000 lb. per sq in.; depending on several different factors. Discoloration or scorching result from heating to 400–500 F. or even at lower temperatures if too long an exposure occurs. Some molding is done without discoloration at 400 F. if the heating does not exceed three to five minutes.

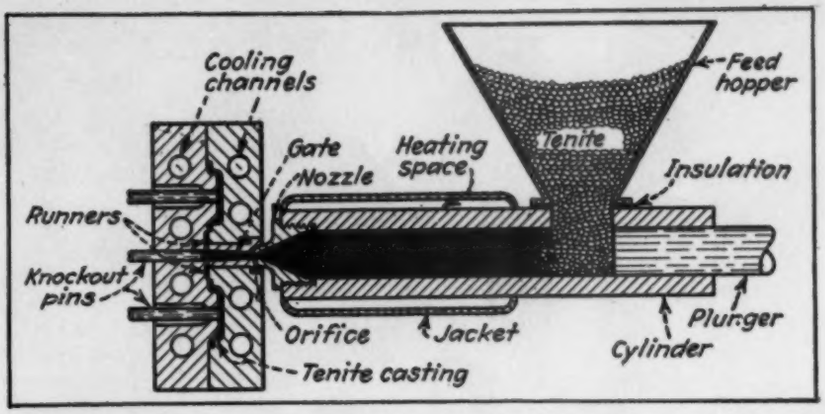


Fig. 3—In injection molding, the thermoplastic is heated in a cylinder and, when softened, is forced into mold cavities through a nozzle, orifice and gate. Granular plastic is fed from the hopper and the plastic is heated, usually by a resistance coil around the cylinder. The mold is brought into contact with the nozzle just before injection starts and the plastic flows through the gate to fill the cavities. Air vents are required

ACRYLIC PLASTICS

Molding of acrylic plastics by compression is done at 285–295 F. for soft grades and 300–315 F. for hard grades at pressures of 1,500–5,000 lb. per sq. in. Although these temperatures can be exceeded slightly under certain conditions, "orange peel" effects become pronounced if temperatures are too high. Injection molding is feasible at a pressure of 25,000 lb. per sq. in., and a temperature of 370–440 F.

STYRENE PLASTICS

These can be molded by compression at temperatures of 280–350 F. and pressures of 300–3,000 lb. per sq. in. Injection molding is done at temperatures of 350–450 F. and pressures of 1,000–30,000 lb. per sq. in., but one maker advises against injection molding below 370 F., as "crazing" on surfaces may result. High fluidity of the heated material makes it possible to fill out remarkably thin sections, and thin gates are feasible in the injection molding of pieces having thin sections.

ETHYL CELLULOSE PLASTICS

This group can be molded either by compression or injection. In the former, temperatures of 320–360 F. and pressures of 1,000–5,000 lb. per sq. in. are recommended, and in the latter recommended temperatures are 380–420 F. with pressure of 3,000–30,000 lb. per. sq. in.

MOLD CONSTRUCTION

Fig. 1 shows a semi-positive mold such as is suitable for thermosetting plastics and is especially recommended for urea plastics. Entering the mold cavity *A* is the male portion or "force" which applies pressure to the plastic. A vertical flash is formed in the clearance space *B* and the land *C* forms a horizontal flash cut-off. Channels for steam heating *D* are both in halves of the mold and guide pins *E* are employed much as in stamping dies.

In Fig. 2 is shown a compression mold for thermoplastics, there being two cavities shown in the vertical section. These are repeated, as shown in the plan view, as many times as necessary to give the required production rate. In this case the cavity blocks have to be split and made removable because of the shape of the pieces being molded. Inserts of steel form the shanks of the knobs. As compression molds for thermoplastics have to be heated and cooled rapidly, there are several channels and these are made quite large to provide for free flow and to reduce the weight of the material in the mold itself that must be heated and cooled. Fig. 3 is a diagram of an injection mold, in which knockout pins and cooling channels are provided. Runners usually are made as thin as possible at the point where they join the mold cavities so that the moldings are readily broken off. Gate, runners and moldings usually are ejected in one piece which, on some machines, is struck automatically by a swinging arm and falls through a chute, thus making it possible to run the machines more or less automatically.

PUNCH PRESS WORK

Punching, blanking, shearing and shaving are done extensively on laminated plastics and, to some extent, on other plastic sheets and tubes. The following applies to *laminated* materials: Punching and some other operations vary to some extent with thickness of sheet, character of filler used, and temperature of the sheet. Some sheets can be punched cold, up to a certain thickness. Others require heating; usually the thickness which can be punched is greater when the sheet is hot. Heating can be done on hot plates or in ovens, but should follow the recommendations of the particular maker, both as to temperature and length of heating. Some makes can be heated to as much as 280 F. without injury and others only to 250 F. Too high a temperature may affect the finish of the sheet and too long a heating may make it brittle. Punching should be done within 2 min. or less after heating.

Laminated materials yield somewhat when punched, the hole produced being slightly smaller than the punch. Allowance of about 3 per cent of thickness punched (others say 0.002–0.003 in. for each $\frac{1}{32}$ in. in thickness) must be made for this in punching as well as in blanking. A very close fit between punch and die (approaching a sliding fit for cold work) is required. Stripper plates also should fit the punch closely to prevent lifting at the edge of the hole as the punch is withdrawn. Some recommend that dies be tapered $\frac{1}{4}$ deg. to a point $\frac{1}{8}$ in. below the surface to minimize splitting around the edge of the hole. Progressive dies often are satisfactory, but best results are secured with compound dies which place a spring load on the stripper. Blanking punches should be from 0.001–0.008 in. smaller than the size of blank required. Press speeds of about 150 strokes a minute usually are advocated.

Punched blanks often have rough edges. This can be remedied by *shaving* in a hollow die with a 45-deg. cutting edge, which must be sharp, using a brass or soft steel plunger. Shaving is done hot as a rule, but can be done cold on some materials up to about $\frac{1}{8}$-in. thickness; although heating in oil or water is advocated.

Shearing of sheets up to $\frac{1}{8}$ in. thick can be done hot; some grades up to $\frac{1}{16}$ in. can be sheared cold. Thin sheets can be sheared on hand presses designed for cardboard, but thicker sheets are sheared on power presses. They should be clamped securely close to the knife. Shear blades must be sharp and without clearance, otherwise thin stock tends to creep as the blade progresses across the sheet. Rotary shears can be used for cutting thin strips, but the latter also are cut quickly and accurately on slitting machines. Thick sheets usually are cut by sawing.

Punching, blanking and shearing of *thermoplastics* is feasible in some cases, but such cutting commonly is done with a knife having a sharp beveled edge. *Hard rubber* of some compositions can be punched in thin sheets, using a female die; some work being done hot and some cold. Allowance for shrinkage is required for hot work. Punches having a cutting edge also are used. These have about $\frac{1}{64}$ in. clearance inside to allow the punching to come up through the punch. The latter sometimes having a spring or soft rubber ejector. The outside edge of such punches is tapered about 10 deg. from vertical. Sheets must be heated and cooled uniformly to avoid warpage, cooling under weight often being necessary.

Cellulose acetate sheets also can be punched and blanked with sharp edge tools. To obtain smooth edges the sheet is warmed to about 125 F., not enough to affect its polish. As the material is compressed by the cutting action one edge is concave and the other convex, but this is hardly noticeable on thin sheets. Considerable blanking is done on *pyroxylin* plastics, which work much like cellulose nitrate, the material being warmed and sharp edge punches employed. *Lucite* is blanked similarly, but heating to 180 F. is recommended for this type of material.

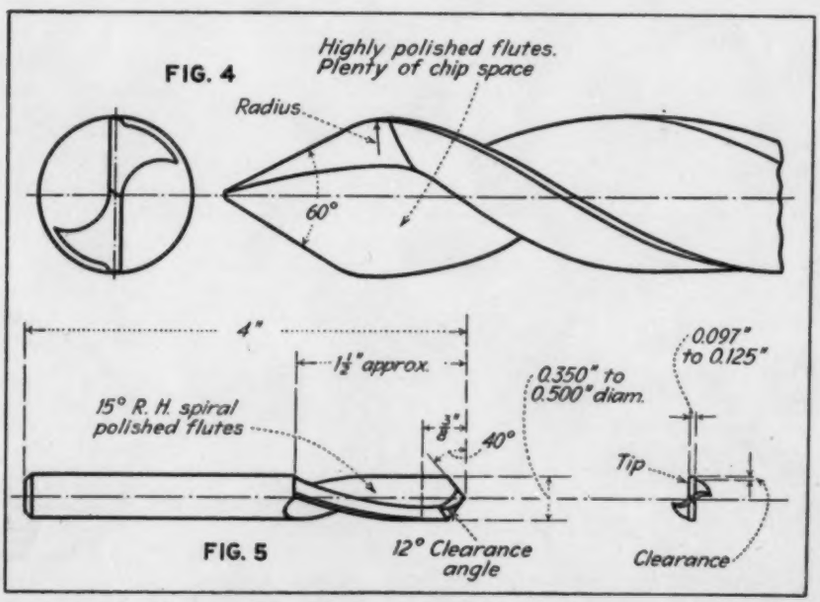


Fig. 4.—Drills for plastics usually have 60–90 deg. included angle points and highly polished flutes. This drill is recommended especially for drilling thermosetting plastics. Fig. 5—Carbide-tipped drills often are used for plastics, many of which contain highly abrasive materials. The drill shown was designed especially for laminated plastics. In this drill, the web is ground to 0.015 in. at the point and increased to 0.060 in. within $\frac{1}{8}$ in.

EMBOSSING

Embossing, as in stamping or pressing letters, often is done in branding parts of plastic materials. Heated brass dies are used. The stock also is heated in some cases. Letters are often wiped in after embossing, but can be made to stand out readily by covering the area to be marked with metal leaf before embossing, the pressure causing the leaf to cling in the recesses where the pressure is applied. Kick presses often are used.

Cast phenolic blanks, previously heated until soft, often are pressed in steel dies to form a design on one surface. This sometimes involves a fairly deep impression requiring considerable flow of material and may include punching of holes, as in buttons.

THE MACHINING OF PLASTICS

Most molded materials can be machined, some quite readily. Often some machining is required, especially the drilling of holes not readily cored. Some grinding or sanding, and some polishing and buffing may be required for fin removal, and for increasing luster or to produce a satin finish. It is best to minimize machine work on filled molded plastics as any machining breaks through the resin film on the surface.

Laminated and cast plastics, and those forms which are fabricated from sheets, rods or tubes, often require much machining. In most instances they can be machined readily, although some laminated materials generally are classed as hard to machine. There is almost as wide a range of plastics as there is of metals. Different types require different machining methods.

All plastics are poor conductors of heat, and heat generated in machining has to be carried away by the tool, air or coolant. Most machining is done dry and, as filled plastics often contain abrasive material, tools are dulled easily and can be burned. The plastic also can be burned and, in thermoplastics, rendered gummy.

In general, it is best to keep tools sharp and often to lap or hone the cutting edge. Clearances commonly are greater than for metals and a zero or negative back rake angle often is desirable. It usually is best to use the highest speed at which overheating of the tool or material can be avoided. Hard, wear-resisting tools are required. Carbide or diamond tips frequently are most economical, especially for long runs.

DRILLING

Standard drills developed for metal often are used, but drills designed especially for plastics, as in Fig. 4, are available. They usually have 60-90 deg. included angle points, polished flutes which are wider than common, and often use a slow helix. One molder recommends a 56-deg. point for thin sections and a 90-deg. point for thicker sections; also, slow helix for through holes and fast helix for blind holes. A 15-deg. lip clearance sometimes is used. Drills should be backed out often to free chips, especially in deep hole drilling. An air jet can be used to keep the drill point cool. Drill speeds usually range from 100-300 ft. per min., but a slow speed of about 75 ft. per min. may be necessary for highly abrasive materials. Fig. 5 shows a typical carbide-tipped drill for laminated plastics.

Drilling laminated plastics: Grind the lip thin, with little rake. Plenty of clearance tends to prevent splitting and grabbing. Do not force; keep the drill sharp and use light pressures. Since the material shrinks, use a slightly oversize drill. For through holes, back with solid material below or use jig plates above and below. When drilling parallel to laminations a flat or "bottom" drill may be used to avoid splitting.

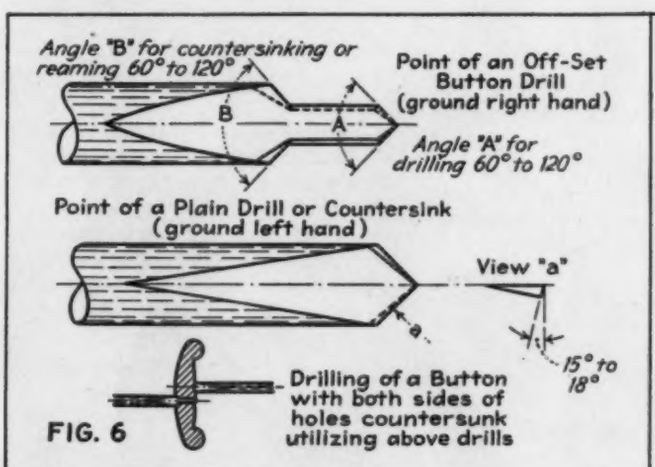
Drilling cast phenolics: Drills sometimes cut about 0.003 in. undersize. Use highest speed without burning and back out often. Negative rake helps to clear the drill. A drill ground as in Fig. 6 sometimes is used for drilling small holes, as in buttons. A half-round drill or boring tool, ground as in Fig. 7, is useful in drilling deep holes when the work is turned, as in a lathe.

Drilling hard rubber: Carbide tips are recommended for high production in drill sizes above $\frac{3}{16}$ in. Some special high-speed steel drills are available. An angle of 90 deg. is recommended on drills smaller than $\frac{1}{4}$-in., but the standard 118-deg. angle is satisfactory for larger drills. For dry drilling, the speeds given in the accompanying table are recommended. Back out frequently in deep holes. A sharp drill avoids crowding

DRILLING SPEEDS FOR HARD RUBBER

Drill Size Inch	Speed R.P.M.	Feed Per Rev. Inch
1	750	0.014
$\frac{3}{4}$	1000	0.012
$\frac{5}{8}$	1200	0.011
$\frac{1}{2}$	1550	0.010
$\frac{3}{8}$	2000	0.008
$\frac{1}{4}$	3000	0.006
$\frac{3}{16}$	4000	0.005

Carbide-tipped drills often are used for drilling hard rubber in sizes above $\frac{3}{16}$ in. The above speeds and feeds are recommended when drilling without lubricant


Angle "B" for countersinking or reaming 60° to 120°
Point of an Off-Set Button Drill (ground right hand)
B
A
Angle "A" for drilling 60° to 120°
Point of a Plain Drill or Countersink (ground left hand)
View "a"
a
15° to 18°
Drilling of a Button with both sides of holes countersunk utilizing above drills
FIG. 6

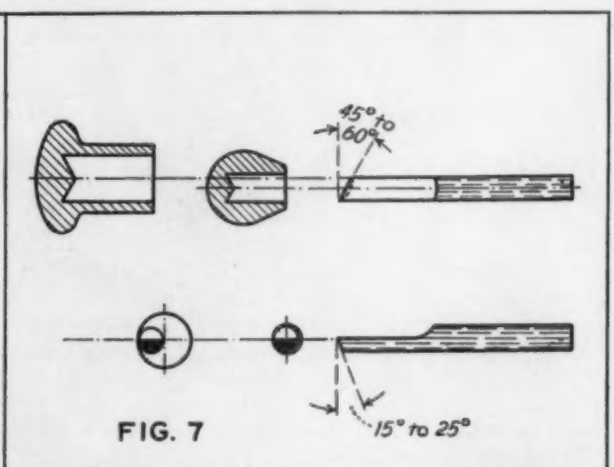


FIG. 7

Fig. 6—For small holes, as in buttons, drills of this type frequently are used when drilling cast phenolics. Drills and countersinks frequently are used in pairs as shown in the lower view. Fig. 7—Half-round drills of the type shown are useful when drilling or boring deep holes in cast phenolics. Sketches at the left indicate maximum and minimum diameters which can be drilled or bored in one operation

and undersize holes. Lubricants help to preserve the cutting edge.

Drilling thermoplastics: For *acetate,* standard drills are satisfactory, but a long tapered point is desirable. Avoid overheating and gumming at the point. Oil aids in producing smoother holes and helps to keep the drill cool. For *Lucite,* standard drills and feeds are satisfactory. Use soap as a lubricant for holes under $\frac{1}{8}$-in. in diameter.

REAMING

Reaming of holes is not commonly done in plastics (except to remove light fins in holes with a hand tool). One maker of laminated plastics states that reaming is difficult, but that fair results can be obtained if an expansion reamer is used with a self-centering floating holder. A fast feed and slow speed (not over 50-100 r.p.m.) are considered necessary. As an alternative, in stock not over $\frac{1}{8}$ in. thick and where close tolerances are required, good results can be secured by drilling within about 0.001 in. of size and then running through the hole a hardened and polished rod which gives a burnishing effect.

THREADING

Tapping laminated plastics: Standard taps usually are recommended, but the high-speed type with ground threads give longer life. Little rake and considerable clearance are advocated. L. A. Valentine (*AM*—Vol. 83, page 179) recommends chrome plating, which proved best in his tests on small taps. He recommends also: speeds ranging from 40 ft. per min. for 0.2362-in. taps to 54 ft. per min. for 0.0590-in. taps; three flutes as better than four; negative rake of about 5 deg. on the front face of lands, which helps to avoid binding in the hole when backing out; some relief on sides of threads. Least wear was secured when tapping dry. Water proved a better tapping lubricant than lard oil or kerosene.

Laminators recommend taps 0.002-0.005 in. oversize and drilling holes larger than for metal or to give 75 per cent full thread to reduce tap breakage. A slight chamfer in the hole avoids "uplifts" of material around the hole. For holes larger than $1\frac{1}{4}$ in. in diameter, collapsible taps increase production.

Threading laminated plastics: Self-opening dies with high-speed chasers are recommended. Special circular chasers with extensions in front are said to give longer life than standard chasers with large chamfer. Dies should have plenty of clearance and should be run at high speed. They should be kept sharp. Threads can be cut on a lathe with a V-shaped tool, especially where fine threads are wanted. Cuts should not be over 0.007 to 0.010 in. deep.

Tapping hard rubber: Standard taps are satisfactory except where high accuracy is required, in which case the tap must be oversize as follows to give a standard thread: up to 6/32 in., 0.002-0.003 in. oversize; up to $\frac{3}{8}$-in., 0.005-0.006 in. oversize; $\frac{3}{8}$ to 1-in., 0.010 in. oversize. Any good grade of tapping oil is recommended. For *threading* hard rubber, regular or self-opening dies may be used with high-speed chasers. Oil is recommended to give cleaner threads and dies should be "snubbed" 15 deg., as for brass.

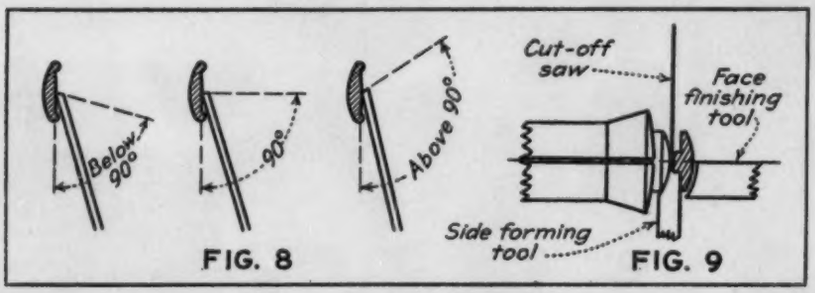


Fig. 8—Cast phenolics can be faced at speeds ranging from 450–6,000 r.p.m. with tools placed slightly above center. Best results are obtained with the facing tool ground as shown in the center view. Fig. 9—When turning buttons with a self-shank, tools arranged as shown have proven satisfactory. Using a thin circular saw for cutoff avoids breaking-off flaws

LATHE OPERATIONS

On laminated plastics, some makers recommend less clearance and more rake than for steel, but others advise using little or no rake on lathe tools. For very smooth finishes, one maker advocates a minimum of $\frac{1}{32}$ in. radius for turning tools. Cutting speeds of 200-600 ft. per min. are advocated for high-speed steel tools and usually 500-1,500 ft. per min. for carbide tipped tools.

In turning *cast phenolics,* tools commonly are given zero or slightly negative back rake and 15 to 18 deg. clearance. For short runs, carbon steel or even hard bronze tools sometimes are used (the latter for convenient sharpening by filing), but tools must be kept sharp and best results are secured when the chips are ribbon-like. In *facing* cast phenolics, speeds range from 450-6,000 r.p.m. Facing tools sometimes are set slightly above center.

On facing tools, too pointed an edge tends to create chatter. Best results are secured with the tool ground as in the center view of Fig. 8. In turning buttons with a self-shank, tools are arranged to advantage as in Fig. 9. The extra facing tool gives a smooth finish and the use of a thin saw for cutoff avoids breaking-off flaws and tends to avoid leaving a central nib. On rod machines, formed circular cutters and cutoff tools can be used to advantage, as in Fig. 10, or cutoff can be done with a saw.

Turning *hard rubber* is done to best advantage with carbide or diamond tipped tools on long runs, but high-speed steels also are used. Tools never should have a lip, as they then tend to dig in. A negative rake of 5-10 deg. and a clearance of 20-25 deg. are recommended. A surface speed of 200 ft. per min. dry or 300 ft. per min. with a lubricant is economical. Feeds of 0.025 in. for roughing and about half this for finishing are satisfactory. In boring, a feed of 0.018 in. is used for roughing and 0.010 in. for finishing. Finishing cuts should be $\frac{1}{32}$ in. or less in depth. Lubricants are advantageous.

Turning of *acrylic plastics* is done with tools having zero rake and plenty of clearance set at an angle of 60 deg. to the spindle. Cuts should be made at a surface speed of about 65 ft. per min., and a feed of 0.010 in. per rev. A smooth surface is obtained with a 0.020-in. depth of cut.

SCREW MACHINE WORK

Screw machine operations frequently are done on laminated stock and are feasible also on cast phenolic, cellulose acetate and acrylic stock. One maker of laminated stock makes the following recommendations:

Laminated tubes are not always concentric, hence it is better to specify a smaller inside diameter than required for finished size, or to use rod and drill to size. Cutting feeds recommended are: 0.007-0.015 in. per revolution for drilling; 0.010-0.015 in. per revolution for turning; 0.002-0.005 in. per revolution for cutoff; and 0.002-0.003 in. per revolution for forming.

The following spindle speeds are recommended for hand screw machines: 1-in. diameter and over, 800-1,000 r.p.m.; under 1-in. diameter, 1,500-2,000 r.p.m. For automatic screw machines, over $\frac{5}{8}$-in. diameter, 2,500 r.pm.; $\frac{7}{16}$-$\frac{5}{8}$-in. diameter, 3,600 r.p.m.; $\frac{1}{8}$-in. diameter and under, 5,000 r.p.m. Another maker of laminated stock recommends, for No. 00G B. & S. screw machines, speeds up to 6,000 r.p.m.; for No. 0G machines, speeds up to 3,600 r.p.m. Flooding with lard oil and kerosene tends to increase production and to prolong tool life.

MILLING OPERATIONS

Milling with cutters such as are used for metals is feasible on many plastics, but is not often required except with the laminated type. It is essential to employ cutters having sharp cutting edges. Carbon steel cutters can be used, but high-speed steel usually is recommended (some advocating the 18-4-2 type) and cutters with carbide tips are considered best of all, especially for long runs. When milling *laminated plastics,* never mill in a direction which will tend to separate the laminations. This is especially important in milling slots. In general, it is considered best to remove the full depth of material in a single cut. Some consider helical cutters better than straight-tooth types.

Cutting speeds and feeds of the range used for brass often are recommended; other recommendations are 400 ft. per min. with carbon steel cutters to three to four times this speed with carbide cutters. Single and double-bladed fly cutters sometimes are used at high speeds with fine feeds. For certain work, where little material has to be removed, a high-speed woodworking shaper with a carbide-tipped tool can be used to advantage.

GEAR CUTTING

Cutting of gear teeth on laminated phenolic blanks is done extensively on hobbers, milling machines and gear shapers. In cutting *Celeron* blanks, it is recommended that the feed be the maximum possible without showing marks on the teeth. A coarse feed tends to reduce wear on the cutter edges. In hobbing, it is not necessary to make roughing and finishing cuts, a single cut to the required depth being made. For *Micarta* gears, the recommendation is to run hobs of 3-4 in. pitch diameter at 140-210 r.p.m. with feeds of 0.040-0.080 in. On shapers, gears are cut at 100-130 strokes per min. with a fairly fine feed, unless both roughing and finishing cuts are taken. In the latter case, 0.010 in. of stock for finishing may be removed at any desired speed or feed. If the shaper has a high-speed head, use of 500 strokes per min. is recommended. In all gear cutting, it is recommended that the laminated stock be backed up with wood or cast iron where the cutter breaks through the edges, to avoid fraying or rough edges at the ends of teeth.

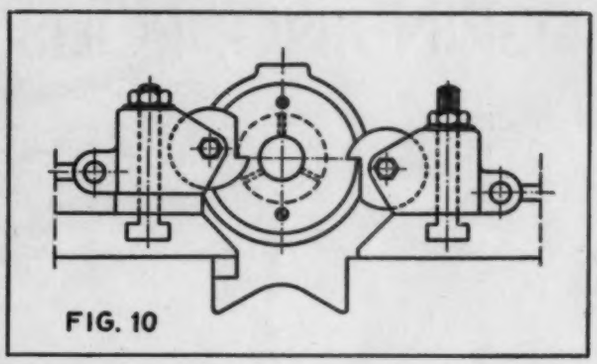


Fig. 10—Formed circular cutters and circular cutoff tools can be used to advantage on rod machines when turning cast phenolics and some other plastics

SAWING OPERATIONS

Sawing of *laminated plastics* is done chiefly on circular and bandsaws, the latter being required for other than straight cuts. They sometimes are used for straight cutting because they run cooler than circular saws. Bandsaws must have set teeth to clear, some advocating half the thickness of blade on each side, so that saws give a width of cut double their thickness. Narrower saws and more set are needed for cutting curves than for straight cuts. Band saws just soft enough to permit filing are advocated, and saws must be kept sharp. Dull saws cause chipping and may result in saw breakage.

Circular saws which are hollow ground and have no set generally are recommended for laminated stock where cuts must be smooth. Where rougher edges are permissible, saws with teeth set the same as for wood are satisfactory, the set making it unnecessary to hollow grind. Decreased set as diameter increases is advocated by some; others recommend radial teeth with zero rake. An accompanying table gives the number of teeth and other specifications for sawing teeth of different thicknesses and tubes of different diameters. Chipping is caused by dull saws or by setting the saw too high or too low in reference to the table. Sawing usually is done dry, but some advocate water as a coolant. Smoother cuts sometimes are obtained by heating the material.

Sawing *cast phenolics* is done with band, circular and jig saws, the latter being used chiefly for inside work or where intricate designs must be cut. Circular saws with little set and having 8-9 teeth per inch, turning at 1,800-2,500 ft. per min. for 8-9 in. diameters, are recommended by one maker. Another suggests 14-15 teeth per inch and speeds of 1,200-1,300 ft. per min. For bandsawing, blades $\frac{1}{2}$ in. wide or narrower are used, these having 14-15 teeth per inch and running at 1,300-1,400 ft. per min. Jig saws can be run as fast as the operator's skill or the machine permits. Sheets often are stacked in cutting out designs, and oiled paper sometimes is placed between sheets to supply a little lubricant.

Sawing *cellulose acetate* can be done with "cabinet" circular saws having 9-12 teeth per inch for thin sheets, or 6 teeth per inch for thicknesses over $\frac{1}{4}$ in. Saws 6-9 in. in diameter are run at 3,000-3,600 r.p.m. and preferably are hollow ground. They usually are $\frac{1}{32}$-$\frac{1}{16}$ in. thick. Water spray gives a cleaner cut. Bandsaws can be used, but guides should be set close.

Hard rubber can be sawed with 3-in. diameter, 0.025-in. thick circular saws without set having 14-20 teeth per inch and running at 1,750 ft. per min., providing the saw is kept sharp. As dulling occurs quickly,

SAWS FOR LAMINATED PLASTICS

BANDSAWS

Type of Work	Speed Ft. Per Min.	Width Inch	Thickness Inch	Teeth Per Inch
Scroll	4000–5000	¼–⅜	0.037	6
Circular Disks — Up to 5-in. dia.	4000–5000	¼–⅜	0.037	6
Circular Disks — Over 5-in. dia.	4000–5000	½	0.037	5
Strips or Blocks	4000–5000	1¼–1½	0.042	5

CIRCULAR SAWS

Material Cut	Speed Ft. Per Min.	Diameter Inch	Thickness Inch	Teeth Per Inch
Sheet — $\frac{1}{16}$-in. thick	2500–3000	10	$\frac{1}{32}$	6
Sheet — $\frac{1}{8}$-in. thick	2500–3000	14	$\frac{1}{32}$	4
Sheet — ¼-in. and over	2500–3000	14	⅛	4
Tubing under 1-in. O.D.	2500–3000	15	$\frac{1}{32}$	8
Tubing over 1-in. O.D.	2500–3000	17	$\frac{1}{32}$	5

Laminated plastics can be sawed with either circular or bandsaws, the latter being used for other than straight cuts

abrasive wheels usually are preferred for cutoff work. Bandsaws leave a rough edge and chip unless sharp, but saws 0.035-in. thick and ⅛-in. wide, with 5-8 points per inch at 3,400 ft. per min. give good results.

Cutoff work on various plastics often is done with abrasive wheels ranging from 0.020 to ⅛ in. thick. For *cast phenolic* plastics, the wheel is flooded with water. Some work is done with 9-in. diameter wheels, 0.045 in. thick, turning at 5,000 r.p.m.; and some with 5 to 10-in. diameter, 0.020-0.040 in. thick wheels turning at 3,500-6,000 r.p.m. Cutoff of *hard rubber* rods, tubes and strips is done with abrasive wheels 8-in. in diameter and $\frac{1}{16}$-in. thick running at 10,000 ft. per min. For cutting sheet, 14 x ⅛ in. wheels are used at 12,000 ft. per min. Wheels should be smooth on the sides, as rubber will burn and glaze. The work usually is done dry. Cutoff of *acrylic plastics* can be done with abrasive wheels if the material be softened by heating to 180 F.

GRINDING, POLISHING AND BUFFING

GRINDING

Grinding of plastics (using a wheel instead of abrasive paper or cloth) is done on machines similar to those used for metal. On *laminated* plastics it is recommended that plenty of water-soluble lubricants or kerosene be used to wash away grindings and keep the wheel free. On *hard rubber*, grinding can be done wet or dry; if wet with water or with cutting lubricant the surface is black and smooth.

SANDING

Sanding with abrasive belts is done extensively on both molded and non-molded plastics. On the former it is used for fin removal, facing and the like, and on the latter for facing and shaping surfaces. The cast phenolics and some other cast materials also are shaped on disks faced with sand or garnet paper. The following practice is recommended:

Molded phenolics: Common grit is No. 60, but for rough operations No. 30 is used. No. 320 abrasive cloth is used on disks where minimum disturbance of the resin surface is essential.

Cellulose acetate: Use belt running at 3,000 ft. per min., often with coarse grit followed by fine. Avoid overheating.

Cast phenolics: Speed should be the same as for sanding wood. Garnet paper clogs less easily than sandpaper. Overheating must be avoided. One fabricator uses 8-in. diameter disks of Nos. 00, 0 and 1 sandpaper, turning at 4,500–7,000 r.p.m.

Hard rubber: Fine sanding is done with No. 0-120 Aloxite cloth, Jean's production cloth No. 4/0-4XJ150 or 3M-ite, or equivalent; the coarser the grain the more apparent are the scratches.

Laminated phenolics: Sand with No. 220 grit and buff with Tripoli or with polishing compound.

POLISHING AND BUFFING

Ashing, polishing and buffing is done on nearly all types of plastics, either to improve the finish, as on some molded parts, or to remove sanding or tool marks left by preceding operations. Ashing is done with wet pumice; polishing usually with special compounds containing wax or the like and sometimes a fine abrasive; buffing is done in much the same way.

Molded phenolics: One molder reports using 8–14 in. diameter muslin buffs turning at about 1,800 r.p.m., followed by a flannel buff for coloring. Chrome polish helps to bring up luster on surfaces previously sanded.

Cast phenolics: Ash with No. 00 wet pumice in 12-in. soft muslin wheels at 1,700–2,500 r.p.m. Some advocate a stitched muslin wheel. Polishing is done on similar soft, unstitched muslin wheels after washing the parts free of pumice.

Cellulose acetate: Ash wet, usually with Nos. 0½, 1, or 1½ pumice or a mixture of these grades, on soft musin wheels ranging from 12–14 in. in diameter and turning at 1,200–1,500 r.p.m. Pieces should be washed and dried promptly. Quicker work can be done in some cases on corn husk or carpet wheels. Buffing, in which some cutting occurs, sometimes is done on 12-in. wheels at 800–900 r.p.m., using red Tripoli. Luster is brought up usually on soft muslin wheels of 12-in. diameter turning at 1,200 r.p.m.

Hard rubber is pumiced and polished on 18-in. canton flannel buffs running at 1,400–2,500 r.p.m., the piece being rotated against the buff. Polishing is done similarly, using stick or cake polishing compounds which are dipped in buffing oil.

Laminated phenolics: After grinding or sanding with No. 220 grit, cotton buffing wheels, with Tripoli or other polishing compounds, will restore luster. Buffing without prior sanding can be done with Tripoli to restore surfaces which have not been scratched too deeply in handling.

Tumbling in pumice and then in polishing compounds often is done on small plastic parts as a substitute for, or supplement to, wheel ashing and polishing. Tumbling also is done extensively, especially on thermosetting moldings, merely to remove thin fins. As a rule, tumbling is done dry, but for cutting-down with pumice and for subsequent polishing on *Lucite*, tumbling in wet pumice is advocated.

Wanted–Profit Engineers

IT'S AN OLD story, but one which needs constant retelling. The story is about the order taker and the salesman.

An automotive authority says that 75 per cent of the cars sold today are bought by the buyer who seeks out a salesman to take his order. That is a universal complaint in the automobile industry —— most of the retail salesmen are not salesmen at all, but order takers.

Unfortunately, order takers aren't confined to the automotive world. They spread over into the machinery world and into the steel world, too.

One industrial equipment buyer has volunteered the information that over 60 per cent of the salesmen soliciting his business do so in a perfunctory manner, as though they are tired of it all. They are bereft of ideas. They don't study the buyer's problems and don't try to help him solve them.

Wendell E. Whipp, president of the National Machine Tool Builders' Association, asserted recently that what his industry needs is not salesmen, but profit engineers. What is the motive for buying a new machine tool, or any other new industrial equipment for that matter? "Profit" is the answer. And the same goes for purchasing steel or any other industrial commodity.

A salesman was going through a Navy yard shop. Seeing a particular operation, he asked about it. He was told that the job took twenty-one hours to do. The salesman said that it could be done better in seven hours. He prepared the data to prove his point and got an order for a battery of new machines. He was a profit engineer, not an order taker. What the entire metal-working industry needs is more creative salesmen like that fellow.

The sales job ahead is a big one. To be specific, the machine tool industry has too little business from private industry which is not traceable directly or indirectly to government orders. Many customers need new machines, but don't know it. Others realize the bad state of their plant equipment, but don't do anything about it.

Steel mills at the moment have too much tonnage capacity. Production facilities are in advance of consumption. One task is to help customers to develop ways of making the product cheaper and selling it for less money, thus widening the market. Another is to discover new uses for steel.

So there is plenty of room for creative selling to be done. What truth to Mr. Whipp's statement that one thousand profit engineers at work selling machine tools can do more than any other factor to level off the peaks and valleys of an industry which long has conducted a "feast-or-famine" business. And the same goes for the steel industry!

Burnham Finney

GAGING BUSINESS

Production in metal trades will be brisk all summer. Machine tool orders for June are more diversified than in months. Defense program expected to quicken activity.

Production and employment in the metal-working industry promises to be well sustained throughout the summer. Machine tool business in June has been large. Though a healthy share of it originated abroad, the increase in the amount and diversity of domestic orders is notable. Bookings have come from more industries and from more scattered sections of the country than in months. Delivery dates quoted by machinery builders are becoming more extended all the time. In fact, a number of companies are sold out for three to six months ahead. This is beginning to have the beneficial effect of spreading current orders among more plants, thereby stimulating greater prosperity throughout the industry. The volume of outstanding inquiries indicates strong sales of machine tools the next few months. The government's defense program, just now getting into full swing, will have a marked influence in quickening activities throughout the metal trades the entire second half of this year.

NEW ENGLAND—Pratt & Whitney and Hamilton Propeller Divisions of United Aircraft have received an additional order from the French government for $5,000,000 of aircraft engines and propellers. Machine tool companies have considerable English business on hand. Arsenals, Navy yards and private shipyards have been purchasing machine tools. Operations in Massachusetts metal trades took a spurt in May, and the improvement held in June. Electric welder and rod sales are good.

NEW YORK—The French and British have been buying machine tools freely. Russia has been placing business direct rather than through Amtorg. A nice order for machine tools has come from Australia which is in the midst of a defense program. Japanese pending orders for machine tools are impressive. Aircraft parts factories are working at top speed.

PITTSBURGH—Steel output remains well above 50 per cent, but further stimulus to tonnage isn't expected until late in the third quarter. Industrial production is at a higher level than last year. A large manufacturer which intended spending $5,000,000 for new plant equipment this year has greatly curtailed its program. Machine tool orders continue light.

CHICAGO—The summer slump in the metal trades will be small. Farm implement and tractor makers have sold more units this year than last, though dollar volume may be no greater. Sales have been aided chiefly by low-priced tractors. Specialty steel mills are going strong. Chemical machinery builders are doing better than last year. Radio manufacturers report good sales of low-priced sets, but television publicity has hurt demand for high-priced units. Nash is to close for three weeks to install $700,000 of new tools. Fairbanks Morse is developing bus and railway air-conditioning units and opposed diesels for railroads. Production of household appliances is tapering as sales slide off. International Harvester will announce its new light tractor in July.

CLEVELAND—Machine tool sales in June closely paralleled those in May. The amount of business from diversified domestic sources has been encouraging. Prospects for the summer are looking up, too. The steel rate has risen in this district.

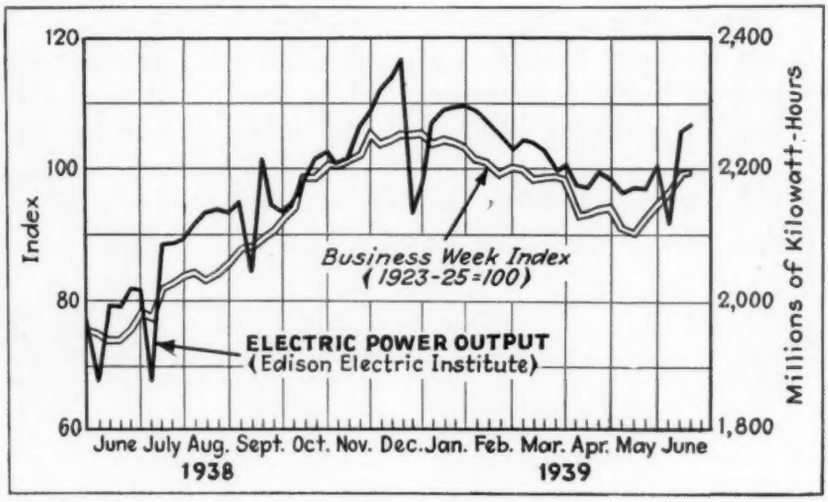
CINCINNATI—Several machine tool companies are running full tilt, with order books filled until the end of the year. Though foreign sales have played a prominent part in this lift to business, two or three builders have a comfortable backlog of diversified domestic orders. Many companies this month are closing for a week for their annual vacations with pay for employees.

DETROIT—Die shops have reached their seasonal peak and anticipate completing current orders for 1940 car tooling by Aug. 1. Machine tool companies already have received inquiries growing out of 1941 car transmission problems. Shop supply sales have been relatively poor. Toledo reports a good volume of machinery orders from diesel engine, motor truck and automotive parts companies.

ROCKFORD—Machine tool companies here are tuned up to a high pitch. One source of orders is Rolls Royce's projected plant in Scotland. Small tool demand has been steady.

POWER CONSUMPTION VS. GENERAL BUSINESS

Once again it looks as though the downward trend of business and industrial activity has been reversed, with electric power consumption running some twenty per cent higher than a year ago



NEWS OF THE INDUSTRY

BRITISH ENGINEERS TO MEET WITH A.S.M.E. IN SEPTEMBER

NEW YORK—The Institute of Mechanical Engineers of Great Britain is coming to the United States this fall to meet Sept. 4-8 with the American Society of Mechanical Engineers. As in 1904, at the time of the St. Louis Exposition, the New York World's Fair is providing the background for this joint gathering.

At the time of the New York meeting the two societies of mechanical engineers will be joined by the Institution of Civil Engineers and the Engineering Institute of Canada who are meeting with the American Society of Civil Engineers. The technical program will be devoted to the mechanical problems of modern transportation, with one session devoted each to marine, railroad, highway, and trans-Atlantic transport. At each session there will be one paper by a British and one by an American speaker. American authorities who will discuss these subjects, respectively, are: Robert C. Lee, Moore & McCormack Co., New York; Charles T. Ripley, Wrought Steel Wheel Industry, Chicago; F. C. Horner, General Motors Corp., New York; and Edmund T. Allen, Boeing Aircraft Co., Seattle.

1939 Machine Tool Show Scheduled for Oct. 4-13 in Cleveland Public Auditorium

Heavy Demand for Space Assures Complete Success of First Show Since 1935

CLEVELAND—Expected far to surpass the last show, which was held in 1935, a 1939 Machine Tool Show will be held in Cleveland's $15,000,000 public auditorium, Oct. 4 through 13, it was announced today by the National Machine Tool Builders Association.

With 85 per cent of the structure's 15,000 sq.ft. of available floor space taken up by actual booths of exhibitors, both the number and range of exhibits will considerably exceed those of the previous show. Balance of the space will contain displays of machine tool accessories and of magazines covering the machine tool field.

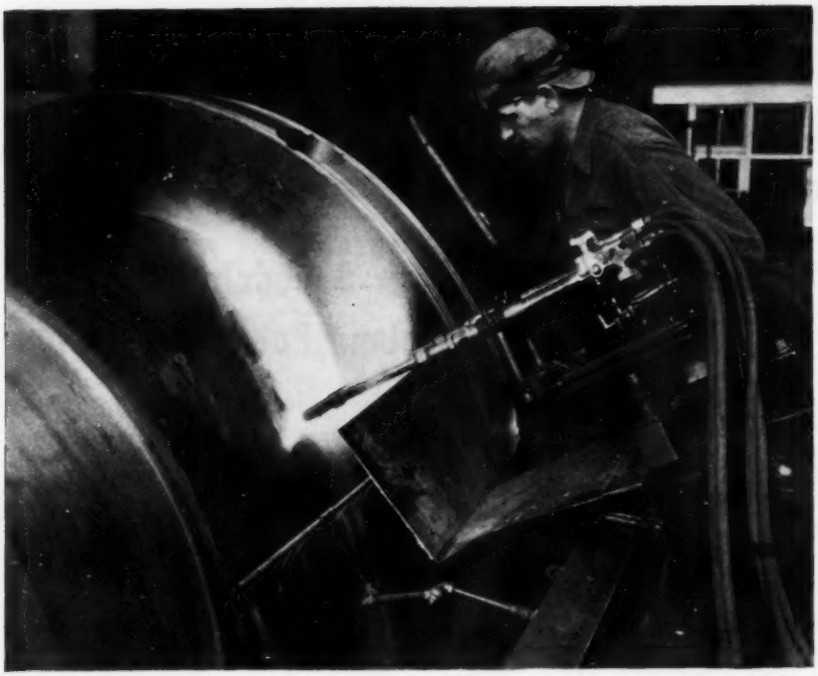
"The purpose of this show is to place under one roof, for convenient inspection and study, the finest and most modern machine tool equipment from every branch of the machine tool industry," asserted Wendell E. Whipp, president Monarch Machine Tool Co. and head of the

DEPARTMENT STORES SELL CROSLEYS

NEW YORK—That distribution of the Crosley light car in metropolitan areas is likely to be effected through department store channels is indicated by the decision of two prominent firms in the New York City area to handle the tiny model. R. H. Macy & Co., New York, and L. Bamberger Co., Newark, N. J., have the automobile on display and are reported selling it for prices around $360. It is understood that the car can be purchased either in cash or financed through the C.I.T., although no trade-ins are accepted. Servicing in the New York area will be handled by the Crosley Distributing Corp.

The Crosley is attracting large crowds at Macy's, who are reported to have sold over a dozen the first day the car was shown.

Machine Tool Show—*Scenes such as this will be reenacted many times over when thousands of executives from every branch of the metal-working industry flock to Cleveland Oct. 4 to study four years of progress at the 1939 Machine Tool Show. Metal-working equipment will completely fill the 6½ acres of floor space in the public auditorium*



Flame Hardening—*Said to be one of the largest applications of surface hardening by the oxy-acetylene process, this 63-in. diameter carbon-steel lathe spindle was flame-hardened with "Airco" equipment by Westinghouse*

TWENTY-YEAR EMPLOYEES ARE HONORED BY NEW DEPARTURE

BRISTOL, Conn.—On June 27, New Departure, one of the oldest divisions of General Motors Corp., reached its 50th birthday and celebrated the occasion by combining its annual old timers party with a dinner for foremen and executives.

Honorary guests included many General Motors executives. Alfred P. Sloan, Jr., chairman, and William S. Knudsen, president, made the principal addresses; while F. G. Hughes, New Departure Div. general manager, pointed out that "No one of us is as smart as all of us." Mr. Hughes presented watches to 30 employees who had completed a quarter of a century with New Departure this year, and gold service buttons to 97 others who reached the 20-year service class. DeWitt Page, General Motors vice-president and former New Departure president, acted as toastmaster.

In the old timers group there was a total of 492 employees who had served New Departure more than 20 years.

National Machine Tool Builders Association. "The last four years have shown substantial advances in the art of machine tool building—advances which mean reduced production costs, increased productivity per dollar invested, and greater potential profits.

"The visiting manufacturer will have ample opportunity to watch various machines in operation, to ask questions and to determine just what tools will be most effective in solving his particular production problems," Mr. Whipp continued. "This year's show is purely a business proposition. Registration fee of $1 is charged mainly to insure that attendance will be confined to people who have a direct dollars-and-cents interest in better machine tool equipment. Rules governing displays have been worked out with a view toward maximum visibility and minimum crowding."

Numerous Meetings Scheduled

Open to all attending the Machine Tool Show will be a series of evening meetings, sponsored by the Machine Tool Congress, featuring talks by outstanding leaders in the metal-working industry. Organizations participating in the Machine Tool Congress are: American Foundrymen's Association, American Society of Mechanical Engineers, American Society of Tool Engineers, Associated Machine Tool Dealers, Cleveland Engineering Society, National Electrical Manufacturers Association, National Foremen's Association, National Machine Tool Builders Association, and Society of Automotive Engineers.

U. S. Government Contracts Awarded to Metal-Working Firms

(Awarded from May 29–June 10 inclusive)

Contractor	Gov't Agency	Commodity	Amount
Welbilt Appliance Corp., Maspeth, N. Y.	W. P. A., Treas., Proc	Gas ranges	56,713
Morris Machine Tool Co., Cincinnati, Ohio	Navy, S. & A.	Drilling machines	24,900
Cincinnati Shaper Co., Cincinnati, Ohio	Navy, S. & A.	Squaring shear	13,789
Dreses Machine Tool Co., Cincinnati, Ohio	Navy, S. & A.	Radial drills	13,235
Lehmann Machine Co., St. Louis, Mo	Navy, S. & A.	Engine lathe	11,640
Rockford Machine Tool Co., Rockford, Ill	Navy, S. & A.	Planer	19,860
Brown & Sharpe Mfg. Co., Providence, R. I.	War, Ordnance	Milling machines	19,909
University Plumbing & Heating Co., Seattle, Wash	Navy, Yards & Docks	Pumping plant	254,700
Harnischfeger Corp., Milwaukee, Wis	Navy, Yards & Docks	Cranes	348,212
McKiernan-Terry Corp., Harrison, N. J	Navy, Yards & Docks	Crane	64,725
United Aircraft Corp., Pratt & Whitney Aircraft Div., East Hartford, Conn	Navy, S. & A.	Engine parts	28,056
Bendix Aviation Corp., Eclipse Aviation Div., Bendix, N. J	War, Air Corps	Starters, switches	441,056
Pump Engineering Service Corp., Cleveland, Ohio	War, Air Corps	Vacuum pump assemblies	63,675
Pioneer Instrument Co., Bendix, N. J	War, Air Corps	Regulator assemblies	52,325
Sperry Gyroscope Co., Brooklyn, N. Y	War, Ordnance	Director parts	47,545
Bethlehem Steel Co., Bethlehen, Pa	Navy, Ordnance	Liner forgings	103,496
Crucible Steel Co. of America, Harrison, N. J.	Boston Navy Yard	Rudder stock	39,887
Russakov Die Casting Co., Chicago, Ill	Navy, S. & A.	Practice bombs	36,000
Bantam Bearings Corp., South Bend., Ind.	Navy, S. & A.	Roller paths	21,080
Messinger Bearings, Inc., Philadelphia, Pa	Navy, S. & A.	Roller paths	108,211
Struthers Wells-Titusville Corp., Titusville Forge Div., Titusville, Pa	Navy, S. & A.	Steel forgings	48,494
Ingersoll Rand Co., Painted Post, N. Y.	Farm Sec. Admn	Air compressors	35,400
Hall-Scott Motor Car Co., Berkeley, Calif.	Navy, S. & A.	Marine engines	85,853
Gisholt Machine Co., Madison, Wis	War, Ordnance	Turret lathe	10,864
Cincinnati Milling Machine & Cincinnati Grinders, Inc., Cincinnati, Ohio	War, Ordnance	Milling machines	33,938
H. R. Krueger & Co., Detroit, Mich	War, Ordnance	Broaching machine	13,041
Cincinnati Planer Co., Cincinnati, Ohio	Navy, S. & A.	Planer	20,149
Lidgerwood Mfg. Co., Elizabeth, N. Y	Navy, S. & A.	Towing machine	48,858
Reliance Electric & Engineering Co., Cleveland, Ohio	Navy, S. & A.	Electric motors	119,581
Ballantine Laboratories, Inc., Boonton, N. J.	War, Signal Corps	Microphones	87,530
Federal Telegraph Co., Newark, N. J	War, Signal Corps	Radio set parts	116,390
American Automatic Electric Sales Co., Chicago, Ill	War, Signal Corps	Office equipment	28,252
Wright Aeronautical Corp., Paterson, N. J.	Navy, S. & A.	Engines	508,269
Liquidometer Corp., Long Island City, N. Y.	Navy, S. & A.	Gages	35,102
Service Tool & Engineering Co., Dayton, Ohio	Navy, S. & A.	Testing sets	21,800
Moore Machinery Co., San Francisco, Calif.	Navy, S. & A.	Press brake	9,672
Watson-Stillman Co., Roselle, N. J	Navy, S. & A.	Forming press	58,500
Wm. Sellers & Co., Philadelphia, Pa	Navy, S. & A.	Turret track machines	130,000
Atlas Car & Mfg. Co., Cleveland, Ohio	Navy, S. & A	Locomotives	56,057

INSIDE DETROIT

By Rupert Le Grand
DETROIT EDITOR

A counter-seasonal rise in car sales is discounted, and model changeovers will proceed as scheduled in July and August. Use of induction hardening increases.

DETROIT—Automobile manufacturers are not excited about the sales pickup in May and early June. Shutdowns for model changeover will not be deferred. Buick will build 17,000 cars during June, and then will probably go down; Chevrolet is shutting its transmission plants about July 1, with assembly plants terminating a few weeks later; and Ford is understood to have set Aug. 11 as the last day for '39 model assembly. Chrysler divisions had planned to work through July before being hit by the Briggs strike, and have recently been working five days a week to get back on schedule.

Best Sales Period

The strength of the late selling season is shown by Chevrolet's report that the first ten-day period of June was better than any similar period in 1939. Its sales were 61 per cent ahead of the same period last year. Buick had a 42 per cent gain.

Factory employment jumped 43 per cent in Detroit and Wayne county during the first two weeks of June, as manufacturers strove to overcome the delays occasioned by the Briggs strike. Some additional workers were required also for catching up with late demand in car sales.

Homer Martin's flop in trying to tieup the General Motors plants in Flint had the effect of stalling off action by the C.I.O. group with respect to shutting down the tool and die shops. The C.I.O. strategy board had to devote its attention for the time being to maintaining large crews at work in Flint and to demonstrating that Martin had no real strength in the plants.

Want Union Label

So a vote to close up the tool and die shops, if U.A.W.-C.I.O. demands are not met, was deferred until last Sunday. The chief bone of contention will be a supplementary agreement to recognize the C.I.O. group as the union, and the second hurdle will be adoption of the union label on dies and tools so as to eliminate "alley shops" from General Motors contracts (the "alley shops" being defined as those employing non-union labor). The C.I.O. says that there is still plenty of time to negotiate, and to pull the strike if necessary. The die program, being unusually large this year, can not be finished before July 15 at least.

WILL RETURN TO RUNNING BOARDS

DETROIT — Runningboardless cars may appeal to men, but women find difficulty in getting into them without an interested audience. Therefore, runningboards will be continued on 1940 cars. After having given an option on some 1939 lines, certain manufacturers are worried about the public reaction if they revert entirely to the earlier design.

Simplified Heat-Treating

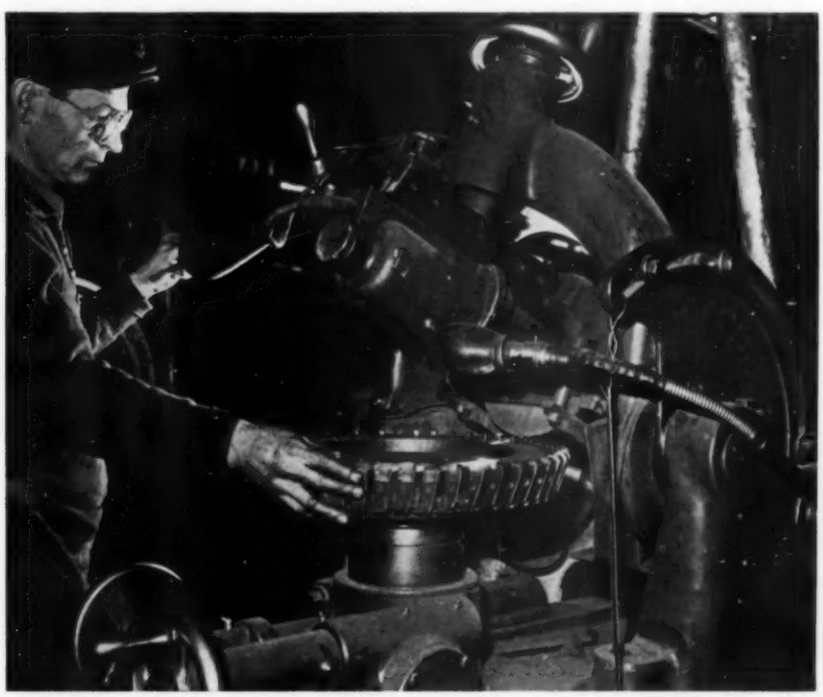
Induction hardening is getting a strong play in 1940 parts manufacturing programs. Valve tappets, rocker arms, rocker-arm shafts and transmission drive shafts are to be locally hardened by the induction process. Parts will be heat-treated right in the production line in special automatic or semi-automatic machines and the trucking of the parts to a central heat-treating department will be saved.

The local hardening method will permit parts to be produced with the most desirable properties in the various portions, such as tough in one section and hard in another, with the depth of hardness controlled within precise limits. Wear-resisting properties of certain parts will be markedly improved by a simple, cheap application of localized heat-treating, whereas otherwise they might not get such improvement if heat-treating the entire part were too costly or undesirable for other reasons.

Troubles with Plastics

Adoption of plastic engine hoods, doors and rear-deck doors may be held up for lack of suitable chemical dyes to match painted metal bodies, according to remarks of Dr. J. L. Laird of the Ford Motor Co., when speaking before the June meeting of the Detroit section, American Society of Tool Engineers. And evidently soybean materials are none too good or will not wholly replace other resins. A recent innovation in Ford press design is a machine that will produce either plastic parts or metal oil pans, according to the tooling installed and the valving of the hydraulic system.

Unit bodies like the Lincoln-Zephyr appeared probable for 1940 when the subject was investigated a few months



The Old Grind—*Every eight hours the cutters that mill Pontiac cylinder block surfaces are reground on this special machine. Wheels must be within ½ point of specified grain and grit. Accuracy is held to 0.002 in.*

ago. It is understood that Chrysler engineers toyed with the idea considerably. Now it does not appear that the unit body will gain new converts for another year at least. New-type overhead conveyor systems must be installed to handle assembly of running gear to the unit body and frame. Other expensive alterations in methods and equipment would have to be undertaken.

Working on Automatic Transmissions

General Motors has bestowed the name "Detroit Transmission Division" on the new automatic transmission manufacturing plant now being established in the old Fisher Body Building No. 10. While no announcement has been made by the corporation concerning this new division, it is believed that a report published earlier (*AM*—Vol. 83, page 226) is substantially correct. The previous activity at Buick's plant No. 66 with respect to automatic transmissions is now concentrated in a separate division set up under the direct guidance of Mr. Knudsen and his manufacturing staff.

Building 10 has undergone a face-lifting operation to create modern offices, and the manufacturing floors are being made ready for the $2,000,000 worth of new precision machinery plus the high-class tools used previously at Flint. About 1,000 men will be employed and the project is expected to get under way by late summer in producing at least 30 automatic transmissions per hour. Design changes are still being made, which is indicative of the troubles in making such a device.

DEFER ADOPTION OF SYNTHETIC ENAMELS FOR AUTO FINISHING

DETROIT—There is little liklihood that any General Motors car will be finished with synethtic enamel instead of lacquer during 1940. Chevrolet is probably in the best position to swing over, since many of its recent oven installations are designed to permit the use of either material. But no steps have been taken, it is understood, to provide pressure rooms and other changes needed for an enamel job.

Of the few major finish suppliers who sell to General Motors in huge quantities, it is believed that any or all of them could or would sell a synthetic finish.

With most ample research facilities, it is obvious that General Motors has tested and counted the cost of changing to synthetic enamels of many different kinds. And yet the corporation remains unconvinced that the best and most economical job can be obtained with an enamel finish.

The chief tendency in oven design is to speed up the baking time to increase the economy of operation. For example, the speed of air circulation is being greatly increased in order to bake the finish faster. Direct firing is preferred by the car manufacturers because it is cheaper, but paint makers would like to see indirect firing become general. This would permit them to make their finishes practically 100 percent synthetic instead of a mixture as is now frequently the case.

Test for Efficiency—*All carburetors turned out in the new $600,000 "village" factory of the Ford Motor Co. are given extensive tests in the specially built machine above. Located in rural Michigan, the plant employs more than 200 local workmen to manufacture approximately 2,000 carburetors a day*

TO BUILD NEW ALUMINUM MILL

OTTAWA — Aluminum Co. of Canada is starting work on a new mill in Kingston, Ontario, which, with plant extensions at Arvida and Shawiningan Falls, Quebec, will cost $7,000,000. It is understood that the British Government is supplying part of the capital, spending $13,500,000 with the company as a capital contribution and for finished aluminum for war planes. The Kingston plant will be ready next spring. At the same time the British aircraft contract with Canadian Associated Aircraft has been extended to a ten-year period.

WARREN H. McBRYDE NAMED FOR 1940 A.S.M.E. PRESIDENT

STATE COLLEGE, Pa.—Warren H. McBryde, consulting engineer, San Francisco, Calif., was nominated for 1940 president of the American Society of Mechanical Engineers at a meeting of the organization's nominating committee here.

Named as vice-presidents for the 1940 term were: Kenneth H. Condit, National Industrial Conference Board, New York, N. Y.; Francis Hodginson, Columbia University, New York, N. Y.; J. C. Hunsaker, Massachusetts Institute of Technology, Cambridge, Mass.; and K. M. Irwin, Philadelphia Electric Co., Philadelphia, Pa. J. W. Eshelman, Eshelman & Potter, Birmingham, Ala.; Linn Helander, Kansas State College, Manhattan, Kan.; and G. T. Shoemaker, United Light & Power Service Co., Chicago, Ill., were nominated for managers.

ANNUAL SILVER BAY MEETING SCHEDULED TO BEGIN AUG. 30

NEW YORK—The 22nd Silver Bay Industrial Conference, held annually to promote better industrial relations, has been scheduled for Aug. 30—Sept. 2 at Silver Bay, Lake George, N. Y.

Expected to participate are executives, personnel and public relations directors, managers, foremen, superintendents, workers, educators, editors, representatives of service organizations and leaders in other related fields. The tentative program includes for discussion trends in managements' responsibilities, stabilization of employment and wages, the National Labor Relations Act in the light of recent developments, techniques of constructive collective bargaining, and accepted handling of sick benefits, hospitalization and medical care.

N.A.M. NAMES SUB-COMMITTEE TO STUDY U.S. PATENT SYSTEM

WASHINGTON—A study of the present patent system to determine if there is a need and an opportunity for effecting changes which will aid industry will be undertaken by a sub-committee on patent procedure of the Committee on Patents & Trade Marks of the National Association of Manufacturers, it has been revealed by the Department of Commerce.

The personnel of the sub-committee which will conduct the study has been chosen by the manufacturers association from various fields of manufacture and from different sections of the country. Members of the sub-committee have visited the Department of Commerce and discussed the proposed study with Conway P. Coe, Commissioner of Patents, and other officials of the Patent Office from the point of view of the problems which they regarded as especially significant to industry.

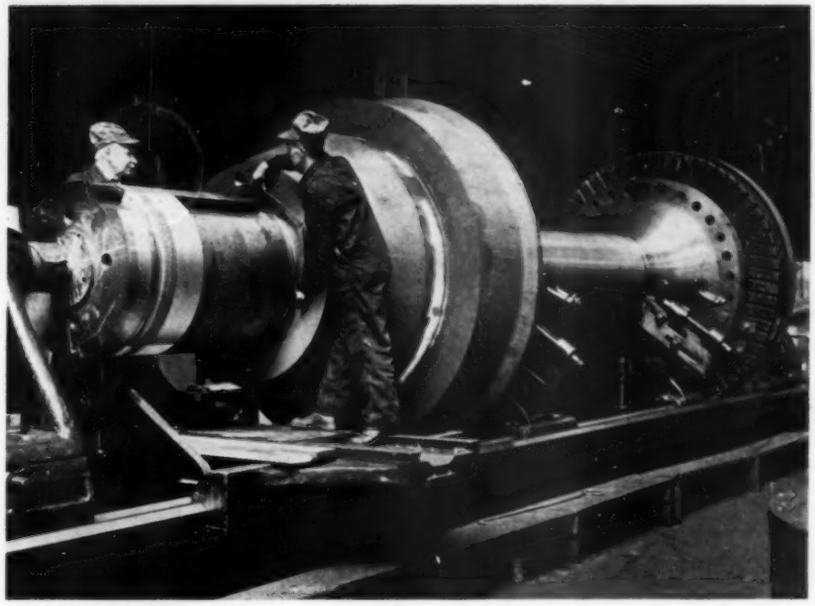
Among the subjects discussed were the simplification of the language of the patent document, especially to make the claims indicate more clearly the scope of the protection given to the patentee; the effect of revisions of the patent system advocated by the Department of Commerce; the delays attending the procurement of patents and the means of obviating them.

Members of the sub-committee include: Henry Lanahan, sub-committee vice-chairman, Thomas A. Edison, Inc., West Orange, N. J.; H. G. Donham, vice-president United Shoe Machinery Corp., Boston, Mass.; H. R. Doty, Hugh H. Eby, Inc., Philadelphia, Pa.; George E. Folk, special patent advisor, Committee on Patents & Trade Marks, National Association of Manufacturers; J. A. Holton, Underwood Elliott Fisher Co., New York, N. Y.; R. T. Moore, Consolidated Packaging Machine Corp., Buffalo, N. Y.; E. A. Terrel, president Terrell Machine Co., Charlotte, N. C.; and R. J. Wean, president Wean Engineering Co., Warren, Ohio.

ELECTROPLATERS ELECT

ASBURY PARK, N. J.—At the 27th annual meeting of the American Electro-Platers' Society held here June 19–22, Ray M. Goodsell, Milwaukee, was elected president, succeeding William M. Phillips of Detroit.

Other officers elected include Frederick Fulforth, Philadelphia, Pa., first vice-president; Joseph L. Downes, Hartford, Conn., second vice-president; and Nelson Sieverling, Englewood, N. J., third vice-president. Reelected executive secretary was William Kennedy, Springfield, Mass.



Production Resumed—*Work again gets under way in the West Allis works of the Allis-Chalmers Mfg. Co., Milwaukee, following a short "work holiday" and strike. Disputes ended in union ratification of a contract essentially the same as the previous one. Shaft being machined above, part of a 30,000-kva., 75-r.p.m. water wheel generator, is 34 in. in diameter, 21 ft. long and weighs approximately 105,000 lb.*

U. S. COMPANY PLANS TO MAKE ENGLISH ENGINES FOR FRANCE

DETROIT—A prominent automobile manufacturer is known to have been conducting negotiations whereby it would build in France the British Rolls-Royce engine for airplanes for the French government. Equipment involved in the tooling up for the Job would be bought mostly in the United States. Officials of this automobile company are known to have returned recently from France.

MEETING GERMAN COMPETITION

WASHINGTON — That American-made lathes are gaining ground in the Netherlands market in competition with German products has been revealed by Assistant Commercial Attache Rolland Welsh, The Hague, in a report to the Department of Commerce. While Germany has always been the most important supplier of this item, a definite shift has recently been apparent from German to American sources of supply.

An outstanding factor in this development is the unduly long delay in the receipt of machinery shipments from Germany. Furthermore, some Dutch buyers have expressed a belief that the quality of the German machinery is deteriorating. This sentiment is exemplified by the fact that one Dutch purchaser paid $5,000 for an American lathe although a German product of similar design could have been purchased for half that price.

RESEARCH VITAL TO PROGRESS, AERONAUTICAL SURVEY SHOWS

NEW YORK—American manufacturers of airplanes, engines and propellers spent $44,000,000 in research and development work to improve the airplane during the last five years, according to a survey of the industry made public recently by John H. Jouett, president Aeronautical Chamber of Commerce of America. That development work actually cost the industry 63 per cent more than its net profit for the five-year period.

"As a result of the industry's heavy investment in technical development, it has continued to produce airplanes of recognized superiority throughout the world," Mr. Jouett asserts. "That is evidenced by the large volume of sales abroad despite the most intense kind of competition from some foreign industries which have been aided by their own governments with liberal subsidies and credits."

Exports during the five-year period amounted to $143,000,000, over 30 per cent of the total production, the survey revealed. Purely commercial sales inside the United States aggregated $107,000,000, or almost 23 per cent of the total.

WATCHING WASHINGTON

McGraw-Hill Washington Bureau

PAUL WOOTON, CHIEF

Metal-working industry to derive increased benefits from armament expenditures. Elimination of undistributed profits tax seen as merely move of business appeasement.

WASHINGTON—The continued armaments race is piling orders into the United States at a rate of ten million dollars a month for airplanes, machine guns, shells, machinery, explosives and other war materials. If export sales maintain the pace set in the first five months, about $130,000,000 of war equipment will have been sold by American industry during 1939.

France and Britain have been among the best customers. From Jan. 1 to May 31 France obtained export licenses for $20,997,040 of war goods and Britain $14,236,132. Even Canada has bought $1,251,574 of war materials since the first of the year. Australia is launching a preparedness program by increasing her navy and her planes. Last month she ordered $4,270,870 of airplanes in this country.

At the same time the United States is placing huge orders with private industry for planes, aircraft parts, ordnance materials and ship parts. Defense spending will be more strongly felt in the last half of the year than in the first half. An important part of the program is the modernizing of army arsenals and navy yards. Already the Navy has placed many orders for large machine tools, such as plate planers and boring mills. The arsenals will purchase machine tools valued at almost six million dollars before the end of 1939.

Self Liquidating

The President's surprise plea for self-liquidating loans to stimulate business is reminiscent of the early "recovery" days when commitments over and above the federal budget were justified under the theory that they would pay for themselves. Obviously the plan, which calls for government guarantees for loans by its agencies to provide for housing, railroad and farm aid, must be viewed in the light of 1940 political strategy. The proposal mentions a $3,860,000,000 total outlay with $870,000,000 to be spent next year. Part of the program is to advance up to half a billion to foreign countries providing the borrowers spend the money in the United States.

The scheme recognizes the fact that business booms cannot be launched on consumer subsidies alone; the heavy industries must also be helped. It recognizes, too, that good business is good news to the party in power during an election year; and it implies the hope that "self-liquidating" projects will mean self-perpetuating office holders.

Educational Orders Funds Certain

Educational orders appropriations amounting to $32,500,000 have yet to be finally approved by Congress, but are almost sure to come through with flying colors. Army officials had some squeamish moments when Congressmen argued that the best educational orders were actual production orders placed for much-needed materials; if such production orders were awarded, what was the necessity for allotting educational orders too? Congressional committee members finally got the point, however, that the purpose of educational orders is to broaden the number of companies familiar with the manufacturing technique in connection with ordnance items. It is estimated that it will take about a year for the War Department to distribute educational orders after funds become available. Companies receiving orders then will have two years in which to fill these orders. It is believed that sizable orders will go to some of the large automotive companies.

ONLY "APPEASEMENT"

The ease with which the tax bill boosting normal corporation income taxes but eliminating the penalty tax on undistributed earnings was passed was almost unbelievable. The fact is the bill is just a stop-gap; the real fight will come later. If business does not "respond" to this appeasement measure, the White House will demand reenactment of the undistributed profits tax. The treasury will ask for more revenue to narrow the gap between receipts and spending. The La Follette plan for reducing exemptions on personal income taxes, now endorsed by the President, will be up again, but won't have much chance of passage until after the 1940 election.

Favor Bartering with Germany

Farm pressure is increasing for some arrangement permitting interchange of goods with Germany. The feeling is that a market for hundreds of millions of pounds of lard, of cottonseed products and for large amounts of wheat is being thrown away. No reason is seen why we should stop trade just because we do not like Hitler. The French and British dislike German policies as much as we do, but they are losing no opportunity to exchange goods with Germany.

Criticize Import Duties

There is considerable comment in administration circles that it is foolish to levy import duties on strategic war materials most of which must be secured wholly or in part from foreign sources. It is a fact that eleven of the seventeen materials listed by the Army and Navy Munitions Board as strategic are dutiable. Imports totaling $30,000,000 last year had to pay duties of $11,000,000. On the other hand, knocking the props out from under duties would put a great handicap on domestic producers of manganese, tungsten, chromium, antimony and other materials.

Possible Embargo on Scrap Steel

If tension increases in the Far East, an embargo on scrap steel may be in the cards. Administration leaders are known to have considered a quota plan which, without naming names, would hit Japan the hardest. No immediate action, however, is looked for. Heretofore proponents of scrap licensing bills have been blocked by State Department opposition and because no scrap shortage existed.

May Investigate Trade Associations

Trade associations may be up for close scrutiny again. It seems that government bureaucrats are already planning their budgets for the fiscal year beginning July 1, 1940. Agencies with regulatory and investigating power whose policy largely determines the extent of their activities are now canvassing their staffs for ideas. Such ideas are numerous. One of the ideas is that trade associations should be put under the spotlight. The suspicion exists that many trade associations are sticking to N.R.A. practices that are considered illegal by the Federal Trade Commission.

METALS EXPORTS TO GERMANY INCREASE DESPITE DIFFICULTIES

WASHINGTON — Notwithstanding the general recession in Germany's trade relations with the United States, American exporters of non-ferrous metals have expanded markedly their trade in the Reich during the past three years, according to a report from Consul S. B. Redecker, Frankfort-on-Main, made public by the Department of Commerce.

Imports of non-ferrous metals into the German market from the United States increased in value from $9,880,000 in 1936 to $32,177,200 in 1938, the report shows. The share of the United States in Germany's import trade in ores and metals increased to 16.8 per cent in 1938 from 8.9 per cent in 1936. Especially sharp gains were recorded in imports of copper, brass, and lead. Imports of copper metal last year from the United States totaled 62,330 metric tons compared with 23,395 tons in 1937 and 6,568 tons in 1936. For old and scrap copper the corresponding totals were, respectively, 11,452, 13,178, and 5,706 metric tons; for old and scrap brass, 7,630, 3,862 and 1,508 metric tons; and for lead metal, 2,157, 1,168, and 1,940 metric tons, statistics show.

In contrast to the expansion of American metal deliveries to Germany, that country's metal shipments to the United States decreased to a value of $946,000 in 1938 compared with $1,266,000 in 1937 and $1,640,000 in 1936. While the United States accounted for 2 per cent of Germany's metal export trade in 1936, its share of that trade decreased to 1.3 per cent in 1937 and to only 1.2 per cent of the reduced total trade in 1938.

FURNACE MEN NAME OFFICERS

NEW YORK—C. T. Holcroft, Holcroft & Co., Detroit, Mich., was elected president and chairman of the Industrial Furnace Manufacturers Association at the organization's meeting here June 21. Other officers elected include Stewart M. Clarkson, executive vice-president; Randall E. Riley, secretary; and C. F. Cone, George J. Hagan Co., Pittsburgh, treasurer.

Those elected to the association's board of directors comprise: J. A. Doyle, W. S. Rockwell & Co., New York; J. W. Barker, Rust Engineering Co., Pittsburgh; J. E. Frazier, Frazier-Simplex, Inc., Washington, Pa.; R. E. Talley, George J. Hagan Co., Pittsburgh; A. B. Clark, J. O. Ross Engineering Corp., New York; R. W. Porter, Swindell-Dressler Corp., Pittsburgh; and G. W. Tall, Jr., Leeds & Northrup Co., Philadelphia.

MACHINE TOOL INDEX SOARS

CLEVELAND — Because of a sharp spurt in orders, the monthly machine tool index, compiled by the National Machine Tool Builders Association, advanced 64 points to reach 219.8 for May, the highest since April, 1937, when the figure reached 282.5.

The association pointed out that although orders for foreign delivery for the first five months of 1939 were heavier than in 1937 and represented a larger share of the total, "the growing strength of domestic orders may be estimated from the fact that the total domestic business placed for the first five months of this year is 43 per cent above the total for the last five months of 1938."

DATE OF LEIPZIG FAIR SET

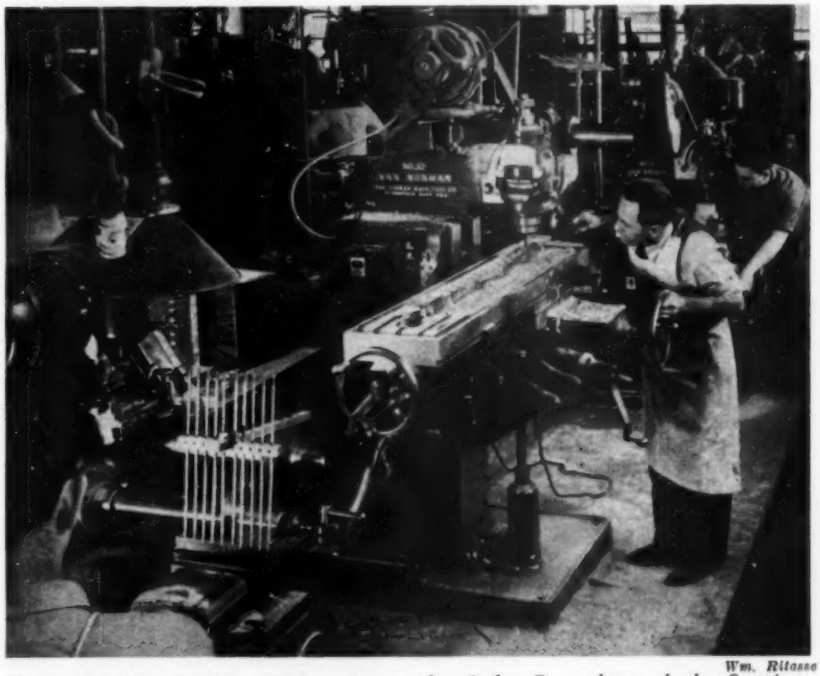
NEW YORK—With 6,000 firms from 25 countries expected to display their standard wares and newest items, the historic Leipzig Trade Fair will hold its 1,982nd session this year from August 27-31. Offering a preview of nearly every conceivable art and industrial product carried by department and specialized stores, the fair will include an impressive building show with demonstrations of the newest building methods.

RISING DEMAND FOR MAGNESIUM FORCES EXPANSION OF PLANT

CLEVELAND—American Magnesium Corp., Cleveland, Ohio, one of the country's largest producers of magnesium products, has put into operation a new foundry in Los Angeles, Calif., to serve West Coast aircraft builders, and contemplates additional construction in the near future as demand for the metal increases.

Although aircraft applications consume about 60 per cent of the magnesium alloy fabricated in the United States, other industrial uses for the metal as a weight saver are rapidly increasing in importance. Since castings produced from commercial magnesium alloys weigh less than a quarter of those made of steel, this metal is rapidly finding extensive use in such equipment as portable tools, vacuum cleaners and sewing machines.

Not to be discounted, of course, is the importance of this material in the aircraft industry. Over 50 lb. of the alloy is used in some airplane engines alone. Major motor parts such as crankcases, supercharger diffusers, blowers, intake manifolds, oil pumps and valve covers are fabricated from alloys of this material. In the planes themselves it finds application in such parts as landing wheels, control levers, brackets, and rolled and extruded shapes for various uses. Forged propeller blades of magnesium alloys are in experimental development and may soon be in use.



Wm. Ritzau

Up and Up—*Production capacity at the Oaks, Pa., plant of the Synthane Corp., laminated phenolics fabricator, goes up and up with the installation of successive Van Norman universal millers. Latest addition, above, is a special unit with a 38-in. longitudinal table travel. Swiveling cutter head permits milling at almost any angle without special tooling*

RADIO MAKERS SAY TELEVISION IS SUFFERING FROM BALLYHOO

CHICAGO — With sales charts on higher priced radio sets falling like icicles in a spring thaw the Radio Manufacturers Association felt called upon to make an official statement playing down television at its fifteenth annual convention held here June 13-17.

"Because television has suffered from over-statement, and because the inauguration of television in New York may arouse false and ungrounded hopes in the minds of the people throughout the country——" began the statement wherein A. S. Wells, reelected president of the association, went on to point out that television is something that only those living in New York may now enjoy in a limited way. A few additional stations are in prospect while others will develop when the solution to the financial side of such broadcasting can be found. Technical difficulties will prevent over 90 per cent of the geographical areas of the United States from being served for some time to come, as the effective range of television broadcasting at present is about 50 miles. Programs are limited to a few hours per day and will be for some time because of their experimental nature.

Deny Television "Is Here"

The association's television committee which brought out the official statement includes Eugene McDonald, Jr., president Zenith Radio Corp., and David Sarnoff, president Radio Corporation of America. Mr. McDonald has frequently said that television sets are not yet ready for sale to the public. R.C.A. recently began "telecasting" from the Empire State Building and announced the public sale of receiving sets. T. A. M. Craven, member of the Federal Communications Commission, said "it would be foolhardy for the industry to lead the public into the belief that television is here as a practical reality."

Mr. Wells, president Gardner-Wells Co., Chicago, was reelected president; L. H. Muter, president The Muter Co., Chicago, was reelected treasurer; and Bond Geddes, Washington, D. C., executive vice-president of the association. Directors elected include J. McWilliams Stone, St. Charles, Ill.; James S. Knowlson, E. F. McDonald, Jr., and James C. Daley, Chicago; Glenn W. Thompson, Columbus, Ind.; R. F. Sparrow, Indianapolis, and H. E. Osmun, Milwaukee.

The National Radio Parts Association Show was held in conjunction with the convention. An estimated 10,000 attended the convention and show where some 200 exhibits of radio parts and accessories were on display.

PERSONALS

W. E. BEALL

WELLWOOD E. BEALL, former chief engineer in charge of commercial projects, Boeing Aircraft Co., Seattle, Wash., has been appointed chief engineer. Mr. Beall received the degree of doctor of science in mechanical engineering and a graduate degree in aeronautical engineering from the Guggenheim School of Aeronautics of New York University. After a period of airplane and motor coach design work in California, he became instructor at the Boeing School of Aeronautics in 1930, and was subsequently placed in charge of all engineering at the school. Four years later he became sales engineer for the company, later becoming active in engineering work, and in 1936 was made chief commercial projects engineer.

THOMAS N. BERLAGE has been appointed director of sales for the Corronizing Div., Standard Steel Spring Co., Coraopolis, Pa.

FREDERICK W. BIERWIRTH, vice-president Western Electric Co. and manager of its Kearny, N. J. works, has been appointed general manager of the company's distributing organization. He succeeds JEROME D. KENNEDY, who will retire Sept. 1. His duties as Kearny works manager will be assumed by HENRY C. BEAL, now manager of the apparatus and cable division there.

J. H. BRAUTIGAM succeeds W. H. SCHERER as manager of the Holyoke works, Worthington Pump & Machinery Corp., Harrison, N. J. This appointment returns Mr. Brautigam to Holyoke at which point he joined the organization in 1928, leaving there to assume his duties as assistant works manager of the Harrison plant in 1932. Mr. Scherer will devote his entire time to the further development of manufacturing methods in all the corporation's plants as assistant to H. C. RAMSEY, with headquarters at Harrison.

RICHARD P. BROWN, chairman Brown Instrument Co. and vice-president Minneapolis-Honeywell Co., Pittsburgh, Pa., has been appointed secretary of the newly created Department of Commerce of the Commonwealth of Pennsylvania.

EARL N. GRAF has been appointed manager of the Pittsburgh branch of John A. Roebling's Sons Co., Trenton, N. J.

B. M. HORTER, former head of the resale sales division, Cutler-Hammer, Inc., Milwaukee, Wis., has been appointed general sales manager. E. W. SEEGER has been named manager of the development department, and P. B. HARWOOD manager of the engineering department.

M. W. LINK, consulting engineer in the research and engineering division, Crane Co., Chicago, Ill., has been made manager of marine sales, succeeding the late C. L. BRUGMAN.

H. H. MORGAN, manager Rail & Track Fastenings Dept., Robert W. Hunt Co., Chicago, Ill., has been nominated for president of the American Society for Testing Materials for the 1939–40 term. G. E. F. LUNDELL, chief of the Chemistry Div., National Bureau of Standards, Washington, D. C., has been nominated for vice-president.

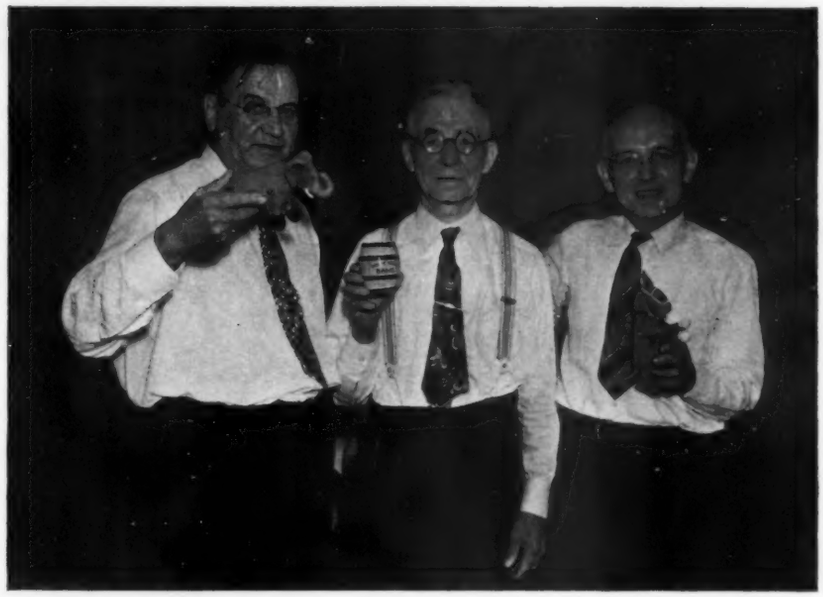
CHARLES R. OGSBURY, for the past 29 years associated with the International Business Machines Corp., New York, N. Y., has been appointed vice-president.

ALFRED REEVES, for the past 25 years vice-president and general manager of the Automobile Manufacturers Association, Detroit, Mich., has resigned. He will continue to serve the association in the capacity of advisory vice-president and will manage the national automobile shows. He will be succeeded by PYKE JOHNSON, vice-president in charge of the organization's Washington office.

L. C. RICKETTS, for the past ten years with the Worthington Pump & Machinery Corp., Harrison, N. J., and recently general superintendent of the corporation's Harrison works, has been appointed works manager. W. D. SIZER, associated with the company since 1920, has been appointed executive engineer in charge of all engineering activities in Harrison. He is succeeded as engineer in charge of the centrifugal engineering division by B. R. MCBATH.

LUKE E. SAWYER, formerly assistant general superintendent of the Babcock & Wilcox Tube Co., Beaver Falls, Pa., has been appointed general superintendent.

N. N. SHEPHERD, formerly with the Carboloy Co., has joined the Firth-Sterling Steel Co., McKeesport, Pa., as a "Firthite" engineer in Chicago. CLIFFORD W. NITCHIE, formerly with the Vascoloy-Ramet Corp., will be a "Firthaloy" die engineer, also in the Chicago district. LESLIE T. MCKINNON, formerly with the Braeburn Steel Corp., will serve as the company's sales representative in Detroit. GEORGE L. SHARPE, formerly with the Tungsten Carbide Tool Co. and the Michigan Tool Co., will be a "Firthite" sales representative, also in Detroit. A. W. MCCOY, formerly with the Carboloy Co. and the Union Wire Die Co., will be a "Firthaloy" engineer, in New York, replacing J. W. MORDICA, who has been transferred to the company's home office. F. H. BECKER has been transferred from Detroit to the New York State territory, making his headquarters in Syracuse, where he will serve as a "Firthite" engineer.



Honors Old Timers—*Cincinnati Milling Machine Co. chairman Philip O. Geier, left, gingerly clings to the sacred G.O.P. elephant as part of the horse-play at the company's dinner honoring exactly 100 employees of 25 years service and over. Right, Tony Fox fondly caresses the donkey, while John Veit, center, proudly displays the bank which admiring old timers filled with coins. Affair was the first such get-together since the firm's 50th anniversary in 1934*

G. S. CRANE

G. S. CRANE, in charge of the sales division, Cutler-Hammer, Inc., Milwaukee, Wis., has been appointed vice-president in charge of sales and engineering. His responsibilities will include supervision of all development work for the company and executive control of the organization's patent, engineering and drafting departments.

Mr. Crane has been associated with Cutler-Hammer for 29 years. After having been manager of the Cleveland sales territory, he was transferred to the Milwaukee headquarters in 1921 as manager of the controller department. From 1925 to 1935 he served as general sales manager, and in 1931 was elected to the board of directors. In 1935 he was appointed vice-president in charge of sales.

R. G. TABORS, formerly located in the Philadelphia office, Baldwin-Southwark Corp., Philadelphia, Pa., has been transferred to Chicago where he will head the sales activities of the Southwark Div.

HAROLD L. TREMBICKI has been named manager of the newly created metal cleaning department of the Cowles Detergent Co., Cleveland, Ohio. Mr. Trembicki was engaged in foreign sales work with the Crucible Steel Co. from 1913 to 1920, was with Oakite Products, Inc., as divisional sales manager from 1920 to 1933, and was president of the Ultrex Chemical Products Co. from 1933 to 1938.

LLOYD R. VIVIAN, advertising manager Ditzler Color Co., Detroit, Mich., has been elected president of the Industrial Marketers of Detroit, chapter of the National Industrial Advertisers Association, for the 1939–40 season. THOMAS B. MOULE, advertising manager Ex-Cell-O Corp., has been elected vice-president; LYLE D. WORDEN, Morse Chain Co., has been named secretary; while JOHN ASHBURNE, JR., Nash-Kelvinator Corp., has been re-elected treasurer.

HENRY A. WEYER, formerly connected with the Nazel Engineering & Machine Works, Philadelphia, Pa., has joined the Chambersburg Engineering Co., Chambersburg, Pa.

J. FREDERIC WIESE, for the past four years assistant vice-president in charge of sales Lukens Steel Co., Coatesville, Pa., has been appointed general sales manager.

FRANK B. WILLIAMS, JR., vice-president in charge of the merchandising division, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has resigned.

M. A. WILLIAMS has been appointed Indianapolis district sales manager, Republic Steel Corp., Cleveland, Ohio. Mr. Williams has been in charge of Union Drawn Steel Div. sales in the same territory and the two positions will be combined.

BUSINESS ITEMS

American Engineering Co., Philadelphia, Pa., has purchased the Diamond Machine Co., Providence, R. I. and will continue the manufacture of the "Diamond" face grinder in its Philadelphia plants.

American Screw Co., Providence, R. I., is establishing warehouse facilities in Detroit, Mich.

Automatic Washer Co., Newton, Iowa, has purchased the Prima Mfg. Corp., Sidney, Ohio. The purchase amplifies the company's "Automatic" household washer line by giving it the right to manufacture special design wringers and "Spin-Dry" centrifugal extractors, both of which

Open House at Monarch—*Climaxing five years of continued expansion, the Monarch Machine Tool Co., Sidney, Ohio, celebrated completion of its new factory and air-conditioned office building with an open house June 24 and 25. A preview was held June 23 for some 400 members of the National Association of Foremen*

have hitherto been exclusive Prima features.

Chandler Evans Corp., Detroit, Mich., is planning to move into a new plant in Meriden, Conn., where it will manufacture fuel pumps and airplane carburetors. The new plant is scheduled to be equipped and ready for operation July 10 and will provide 15,000 sq. ft. of floor space.

Charles Wagner Litho Machinery Co., Hoboken, N. J. has entered the industrial oven field with an extensive line of industrial ovens, including core and mold ovens, drying ovens, armature and coil ovens, conveyor ovens, and other types.

The Dreses Machine Tool Co., Cincinnati, Ohio, has changed its name to The Cincinnati Gilbert Machine Tool Co.

Fredericksen Co., Saginaw, Mich., has changed its firm name to Saginaw Bearing Company.

Independent Pneumatic Tool Co., Chicago, Ill. has opened a branch office in Denver, Colo., under the direction of C. A. TURNQUIST.

Link-Belt Co., Chicago, Ill., has been appointed distributor of the friction clutches manufactured by the Twin Disc Clutch Co., Racine, Wis.

D. J. Murray Mfg. Co., Wausau, Wis., has appointed R. C. Kratz, Philadelphia, Pa., to handle its line of unit heaters, coolers, air conditioning units and other items.

Production Machine Co., Greenfield, Mass., has purchased the Francis Reed Co., Worcester, Mass., manufacturer of sensitive drilling machines.

Ransome Concrete Machinery Co., Dunellen, N. J., welding table manufacturer, has appointed the following representatives for its Welding Equipment Div.: Cheever Equipment, Seattle, Wash.; Victor Equipment Co., San Francisco and Los Angeles, Calif.; Austin-Hastings Co., Cambridge, Mass.

Joseph T. Ryerson & Son, Inc., has purchased the Philadelphia plant property of the Taylor-Wharton Iron & Steel Co., to provide for extensive improvements and additions.

Thomas Truck & Caster Co., Keokuk, Iowa, has purchased the William H. Sippel Corp., South Bend, Ind., manufacturer of skid platforms, floor trucks and industrial trailers. Sippel products will be combined with the Thomas line of casters and trucks, with all production carried on in the Keokuk plant. Machinery and equipment at South Bend have been transferred to Keokuk.

Timken Roller Bearing Co., Canton, Ohio, recently held a five-day open house during which nearly 15,000 people were shown through the company's roller bearing factory and steel mill. Visitors were divided into groups of less than 30 people and each escorted through the plant by a guide who had received a week's special instructions in these duties.

Van Dorn Electric Tool Co., Towson, Md., has opened a branch in Newark, N. J., under the supervision of HARRY BULLOCK, recently transferred from Towson.

OBITUARIES

E. L. BRUGMAN, manager of marine sales, Crane Co., Chicago, Ill., was fatally injured in a recent automobile accident.

ROLAND M. COOK, sales manager Worcester Pressed Steel Co., Worcester, Mass., died June 15 in that city following a heart attack. He was 45 years of age.

BARTON HASELTON, chairman Revere Copper & Brass, Inc., New York, N. Y., died June 18 at his home in Rome, N. Y., following a short illness. He was 61 years of age.

DAVID E. KNALL, vice-president Calumet Foundry & Machine Co., East Chicago, Ind., died June 11 in Chicago. He was 47 years of age.

J. ALBERT MATTSON, 65, New England district sales representative Firth-Sterling Steel Co., McKeesport, Pa., died recently at his home in Chicago, Ill.

FRANK N. MEAD, Milwaukee, sales representative, Firth-Sterling Steel Co., McKeesport, Pa., died recently in that city. He was 66 years of age.

LORILLARD SPENCER, 56, former president of the Atlantic Aircraft Corp. and of the Whittemann Aircraft Co., died June 9 in Newport, R. I.

JAMES W. THORNTON, former superintendent Lake Erie Steel Co., Cleveland, Ohio, and executive of the Republic Steel Corp., died recently. He was 58 years old.

JOHN M. WESTERLIN, president Westerlin-Campbell Co., Chicago, Ill., refrigerating machinery maker, died in that city June 10.

MEETINGS

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Semi-annual meeting, Fairmont Hotel, San Francisco, Calif., July 10–14.

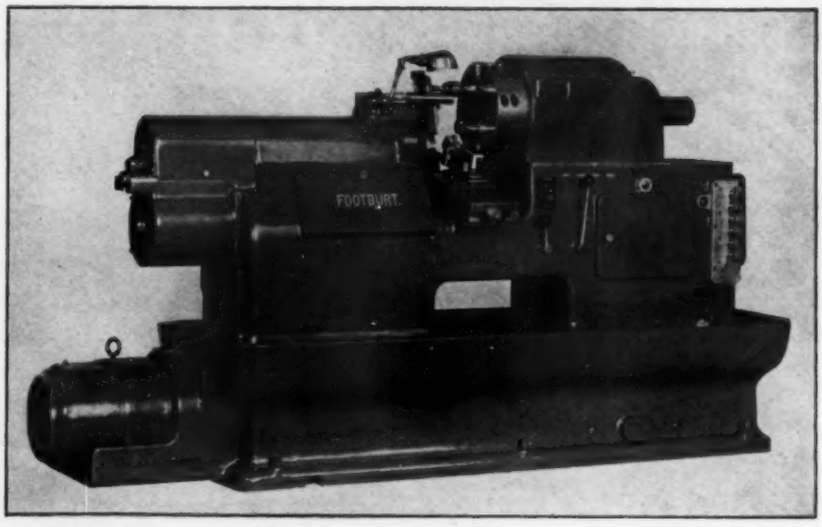
PORCELAIN ENAMEL INSTITUTE. Fourth annual forum, Ohio State University, Columbus, Ohio, Oct. 18-20.

SILVER BAY INDUSTRIAL CONFERENCE. Annual meeting, Silver Bay, Lake George, N. Y., Aug. 30–Sept. 2.

SOCIETY OF AUTOMOTIVE ENGINEERS. National aircraft production meeting, Ambassador Hotel, Los Angeles, Calif., Oct. 5-7. Annual dinner, Hotel Pennsylvania, New York, N. Y., Oct. 16.

SHOP EQUIPMENT NEWS

Quick Set-Up Featured In Hydraulic "Footburt" Automatic



The application of hydraulic drive and control on the "Footburt" No. 1½ single-spindle automatic screw machine, built by Foote-Burt Co., Cleveland, Ohio, affords ease in making set-ups, which is important in reducing costs on short-run jobs. This machine has a normal capacity of 1½ in., but by the use of a solid chuck and shell it will take 1⅝ in. and is efficient down to ½ in. because of the wide range of spindle speeds. Pieces up to 14 in. long can be machined. The spindle is equipped with a chucking device consisting of a roller arrangement working under spring compression which eliminates the usual fingers and is said to be more positive.

Drive to the spindle is by a train of change gears to provide efficient spindle speeds on both steel and brass for all sizes within the range of the machine. Automatic speed changes, including two forward and two reverse speeds, are accomplished by means of a disk plate having adjustable trip dogs controlling hydraulic cylinders for operating multiple disk clutches at any turret hole, or at any point in the feed. It is possible to reverse the spindle at low speed, and immediately trip to high reverse speed, allowing the use of a simple tap holder.

The turret is provided with six holes and is indexed by Geneva motion which makes possible a complete cycle in 8 sec. Feed is accomplished by a drum-type cam having a solid path, the cam being driven hydraulically. A control panel having six micrometer-type knobs for controlling hydraulic valves, one for each hole of the turret, is mounted at one end of the machine. Length of the slow feed is accurately adjusted by the location of trip dogs on a revolving disk plate, two for each station of the turret.

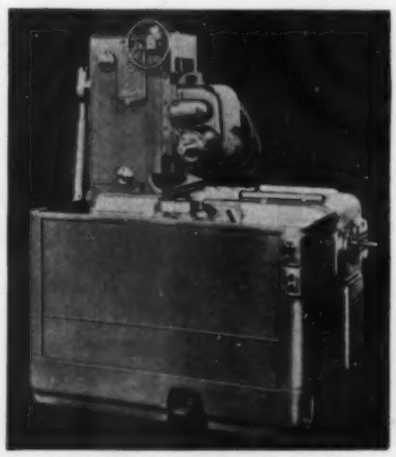
Stock feed and chucking are operated by a cam drum that advances the stock feed tube and controls the clamping of the collet jaws. It is necessary only to turn one screw in order to secure the full range of 14 in. in length of which the machine is capable. Setting-up of the machine is simple, since control levers are arranged both in the front and the rear, and the feed may be stopped at any point in the cycle. Indexing may be done at either fast or slow speed in setting up the machine. Extra attachments, including a high-speed drilling attachment, independent cut-off attachment and double camming for stock feed and chucking are provided. The latter allows two pieces to be machined in one cycle of the turret, providing only three holes are required for each piece.

Specifications: Chuck capacity, 1⅝ in.; bar stock feed, 14 in.; milling length, 6 in.; turret adjustment, 4 in.; distance from turret to face of chuck, 5½-9½ in.; number of turret holes, 6; diameter of turret holes, 1½ in.; number of cross slides, 2; range of spindle speeds, 30-1,000 r.p.m. for steel and 60-2,000 r.p.m. for brass; drive motor, 7½ hp.; floor space, 32½ x 105 in.

No. 50 Gear Chamferer Uses Automatic Cycle

The No. 50 gear tooth chamfering machine announced by Cross Gear and Machine Co., 3250 Bellevue Ave., Detroit, Mich., is an automatic, full-universal machine for rounding, pointing, chamfering and burring all types of internal and external gear teeth. It uses a pencil-point type of cutter. Vertical motions of the cutter are cam actuated and controlled in synchronized timed relation with the rotary motion of the work.

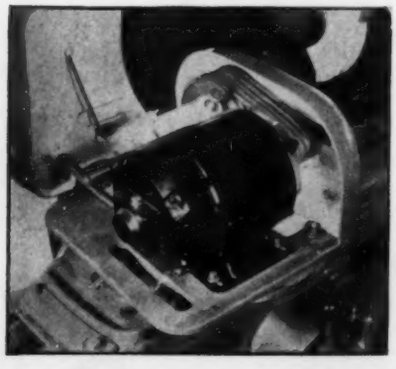
Rated in terms of spur gears, the



machine has the following capacities: pitch, 0–25; face, 0–18 in.; diameter, 0–18 in.; number of teeth, 5–140. Adjustments are available for helical gears of any angle, either right or left hand helix. After the gear is finished, the cutter head automatically is retracted by power rapid traverse, and the cutter is withdrawn from the work. Indexing variations are obtained with standard change gears. Both the cutter and work spindles are designed for climb cutting operations.

Compact Headstock Used On Universal Grinders

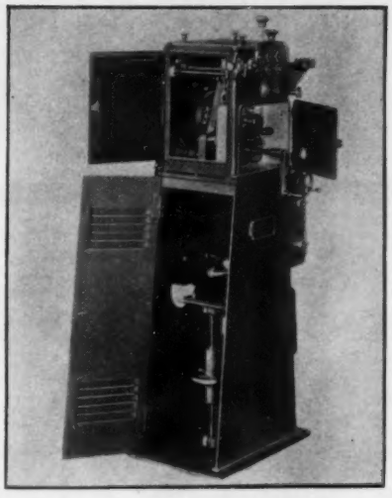
Headstocks now being supplied on all hydraulic universal grinders manufactured by the Landis Tool Co., Waynesboro, Pa., are driven by an adjustable speed motor, operating from either a.c. or d.c. supply. Motor is controlled by means of the work and traverse start and stop lever, which is convenient to the operator regardless of the position of the



work table. Power is transmitted to the spindle by multiple V-belt. An infinite number of work speeds is available, with the speed ratio never less than 6 to 1, and on some sizes as much as 12 to 1. Speed is selected by means of a dial. Spindle and faceplate bearings of the super-precision type are use. Dynamic braking is utilized to stop work rotation. Headstock may be swivelled as much as 90 deg. on its base for face grinding.

Spring Coiling Machine Winds 200 Per Minute

Approximately 200 springs per minute can be wound from 0.004–0.028-in. diameter wire with the improved No. 0 universal segment type spring coiling machine, 24-in. model, manufactured by Sleeper & Hartley, Inc.,



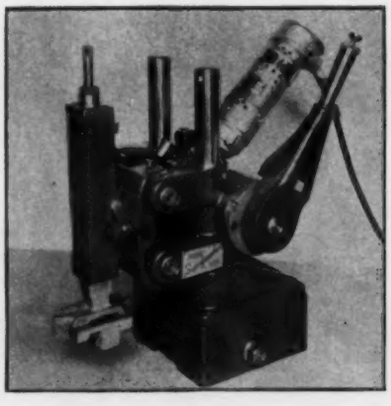
Worcester, Mass. Features of this unit include use of ball bearings throughout, rapid adjustment of compound blocks, and ready accessibility of pitch and diameter cam controls.

With standard equipment, this machine will coil and cut all types of compression and extension springs from any size wire within its capacity. Inside diameter of springs can range from $\frac{1}{32}$ in. to $\frac{1}{2}$ in. Wire feed may be increased from 24 in. to 36 in. on sizes up to 0.002 in. by using auxiliary gearing available with the variable speed transmission drive.

"Superfinishing" Heads Used on Lathes

Standard heads, made in three sizes, with which "superfinished" surfaces can be developed in standard lathes, are offered by Foster Machine Co., Elkhart, Ind. These heads are mounted on the compound of the engine lathe cross slide and practically any cylindrical work within the capacity of the lathe may be finished. These heads can be used for finishing all types of rolls, bearings and tools.

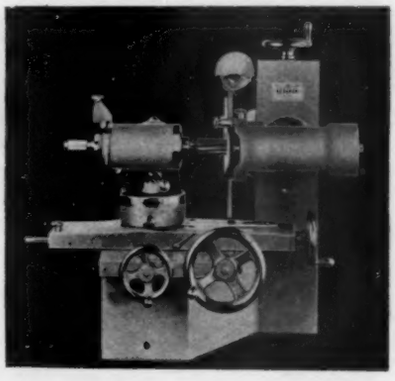
The No. 1 head is recommended



for work up to 3 in. in diameter, and for lathes up to approximately 12-in. swing. The No. 2 heads are recommended for work up to 6 in. in diameter on lathes having up to 18 in. swing. Attachment No. 3 is suitable for work 18 in. in diameter, on lathes swinging approximately 24-in. The length of the cylindrical surface superfinished with these heads is dependant only on the length of the lathe on which the attachment is used.

Type TRS Grinder Has Swivel Table

Similar to the Type EMS-1 grinder previously described (*AM*—Vol. 83, page 447), the Type TRS-1 utility tool grinder offered by Bergram Mechanical Engineering Co., Inc., New Britain, Conn., has an auxiliary swiveling table and an adjustable



tailstock for a center. This machine will grind the land, relief and teeth of straight, spiral or tapered reamers with up to 8-in. length of flute, end mills, shell mills and cutters. Specifications are the same as for the Type EMS-1 grinder, except that longitudinal travel of the table by rack and pinion feed is 8 in.

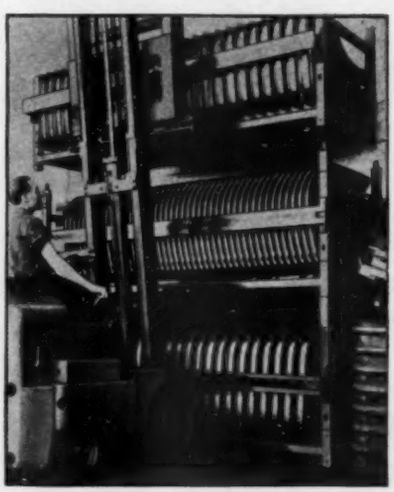
Spindles Lubricated With Kerosene

The Norton Co., Worcester, Mass., has announced that effective June 1, 1939 all grinding machines of their manufacture will be built with kerosene lubrication of the grinding wheel spindle. Spindle journals are finished to a mirror-like surface, accurate in size and straightness to 0.0001 in. and reading from one to two microinches. The real advantage of using kerosene as a lubricant is that it permits the bearings to be set up much closer than is possible with

ordinary types of oil. The journals are flood lubricated. Tests have shown that bearing temperatures increase only about 9–10 per cent over room temperature when lubricated with kerosene. It is claimed that generally a grade softer wheel can be specified with no loss in production, and at no increase in wheel costs. The illustration shows an inspector checking the surface finish of the journals of a 10-in. Type C Norton wheel spindle with a Profilometer.

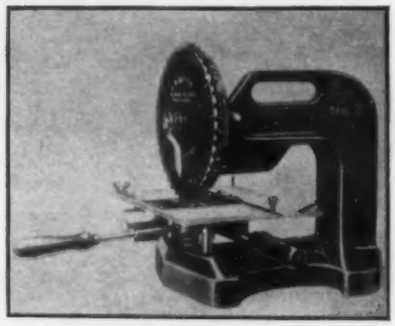
Sectionalized Carrier Performs Two Functions

Sectionalized work carriers of standard dimensions and construction, suitable for either materials handling or storage, have been developed by Mechanical Handling Systems, Inc., 4700 Nancy Ave., Detroit, Mich. These light-weight carriers are made of arc-welded square steel tubing and have sufficient strength to handle loads up to 3,000 lb. The basic unit consists of a $3\frac{1}{4}$ x 9 ft. frame with a 2 ft. 8 in. frame at one end. Other end of the base has a short upright at each corner, each post being open at the ends so that a removable end frame, similar to the permanent one, can be slipped in to form a symmetrical carrier. Floors and sides of either solid wood or metal, or perforated metal where required, provide a bin for small parts. Loaded with parts, sub-assemblies, etc., these work carriers can be stacked in tiers to ceiling height.

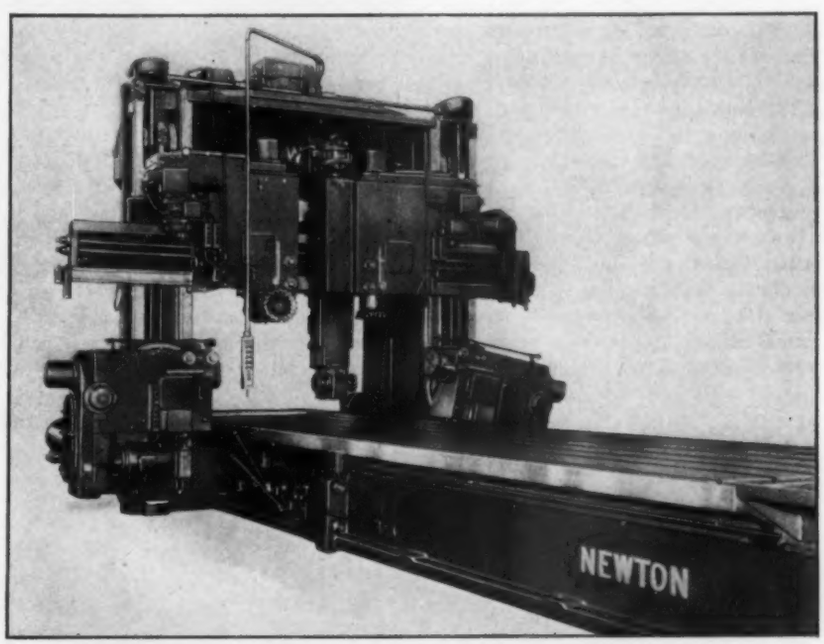


Deep-Throat Marker Holds 8 x 8-in. Plates

The No. 2 stamping machine offered by H. O. Bates, 251 N. Broad St., Elizabeth, N. J., is similar to the No. 1 model except that the throat dimension has been increased to enable the unit to handle larger nameplates. Vertical adjustment for thickness of plate remains $\frac{1}{2}$ in. while the distance from the back of the throat to the face of the dies has been increased to 8 in. Plates as large as 8 x 8 in. can be held on the table, while special fixtures permit stamping strips of any length. Machine is furnished with replaceable dies ranging in size from $\frac{1}{16}$ in. to $\frac{3}{16}$ in.



Newton Planer-Type Milling Machine Employs Unit-Head Box Type Construction



The Newton No. D4½-110 unit head planer-type milling machine shown was built by Consolidated Machine Tool Corp., Rochester, N. Y., for performing various milling operations on a production basis in the manufacture of frames and bases for various sizes of diesel engines. The two horizontal milling heads mounted on the uprights are of the swivelling type, and are adjustable through a wide arc on either side of center. The two vertical heads mounted on the crossrail are non-swivelling and are so constructed that the extension center head can be bolted to either of the vertical heads and to the cross rail. A series of bolt holes in this center head permits mounting it in a wide range of positions vertically with reference to the crossrail, thus keeping overhang at a minimum. This head derives its feed and traverse, both horizontally and vertically, from the head to which it is bolted.

The right-angle milling attachment shown mounted on the left-hand vertical head adds to the versatility of this machine. With this unit mounted as shown, the ends of frames may be

milled without disturbing the set up. Vertical movement of this attachment is obtained from the crossrail. There also is provided a bracket support which may be mounted on the crossrail when required for use with a horizontal arbor driven from either horizontal heads.

Feed and power rapid transverse are provided for each head and for the crossrail through motors connected to gear boxes. Pushbutton control is used extensively, with dual control on each side of the machine wherever practical. A pendant switch controls table feed and traverse, and railhead feed and traverse.

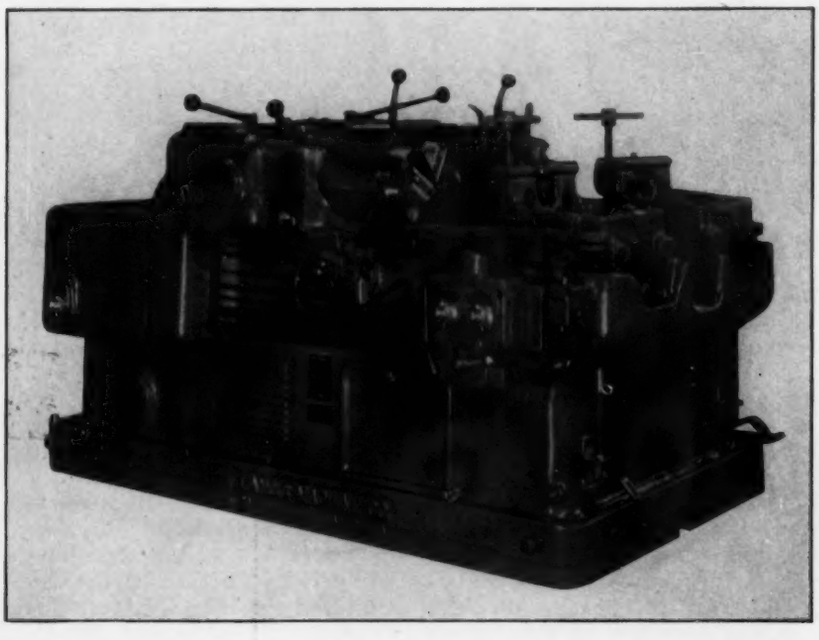
Interlocks are so connected that feed motors stop before the spindle motors do, and should table way lubrication fail for any reason, both feed and traverse motors are brought to a stop. A total of 17 motors, ranging up to 15 hp. are required for this machine. Specifications: width of table, 96 in.; length of working surface of table, 28 ft.; maximum distance from top of table to cutter in vertical spindle, 87 in.; over-all length, approximately 71½ ft.

Hydraulically Operated Turner Features Simplified Operation

The "Lanhydro" hydraulically operated turning machine developed by Landis Machine Co., Inc., Waynesboro, Pa., has been improved to make the hydraulic cycle more flexible so as to suit every kind of material and cutting condition. Operation of the machine has been simplified. Cycle now is controlled by a foot pedal which leaves the operator's hands free for loading and unloading the vises, or work-holding fixtures.

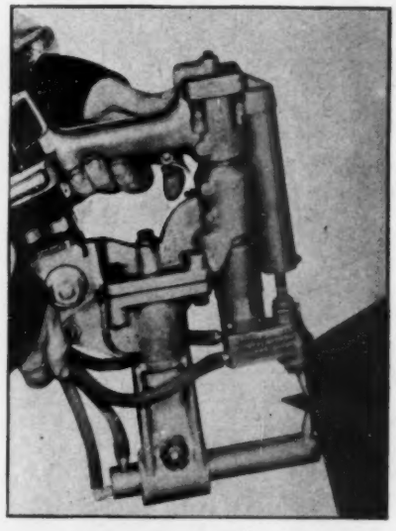
As the cycle is completed, the work is removed from the vise or holding fixture and another piece is inserted, but not clamped. The operator immediately depresses the foot pedal to start the cycle. The carriage then advances rapidly to a position where the work is about to enter the work center located within the bore of each turning head. At this point, the forward movement of the carriage is checked to a very slow forward speed to permit the operator to guide the work into the work center, after which he performs the final clamping operation.

The position at which the fast forward speed of the carriage is checked is made adjustable for jobs of different lengths. Slow forward movement for centering and clamping the work also is variable. After the work is clamped, the carriage again advances rapidly to the position where the work enters the turning head. A coarse turning feed then is used throughout the turning operation. This feed is variable, so that it can be adjusted to suit any material or turning speed.



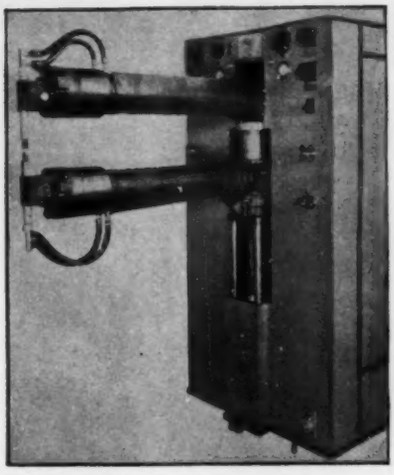
Light Welding Gun Operates Hydraulically

Built almost entirely of magnesium, this light-weight "pincher" type welding gun offered by Progressive Welder Co., 737 Piquette Ave., Detroit, Mich., is operated hydraulically. It is designed for welding currents up to 50 kva. and pressures up to 1,000 lb. Featured is the use of the sliding contact principle of current transmission. Current is carried to electrodes directly through the pressure cylinder and piston, the latter being built into the gun. "Cocking" action of the piston within the cylinder increases welding pressures, insuring continuous contact of the sliding members. Cooling is by means of two water circuits. Gun is available in C-type, scissors, yoke, and a variety of special types to suit many pinch type spot-welding requirements.



Convertible Welder Has 36-in. Throat

This Model 106 convertible spot welder was designed by the Harvey Machine Co., Los Angeles, Calif., for welding aluminum alloys and stainless steels used in the aircraft industry. Machine has a clear throat depth of 36 in., and space between the arms can be varied from 4 to 18 in. With the arms spaced at 16 in. it has a welding capacity of two pieces of 0.125-in. dural. Water-cooled electrode holders are removable and may be clamped either in a vertical position or on a 22½-deg. angle. Pressure is applied to the electrodes by a pneumatic cylinder at the rear of the



upper arm. A regulator on the left front panel provides a continuous range of pressures from 0 to 1,500 lb. Provision has been made for operating the machine on single spots or on repeat spots with a variable delay between cycles.

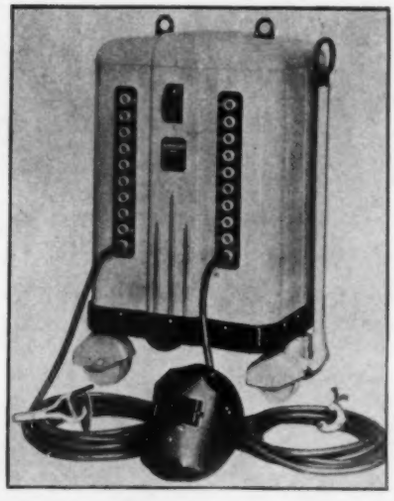
Descaling Apparatus Cleans Iron and Steel

Developed to remove scale and similar accumulations from iron and steel by rapidly heating such deposits with multi-flame tips, this oxy-acetylene

descaling apparatus announced by Air Reduction Sales Co., 60 E. 42nd St., New York, N. Y., causes the cracking off of scale as a result of the differential expansion between the scale and the base metal. This process removes scale from ingots, billets and slabs to expose defects prior to scarfing or chipping, from forgings and steel castings prior to machining, and from steel castings after annealing. Where necessary, the apparatus can be mounted on wheeled carriages for easy travel across flat surfaces. A secondary function of the apparatus is the driving out of occluded moisture from within and beneath the surface scale prior to painting.

New A.C. Arc Welder Has 350-Amp. Capacity

The Marquette Mfg. Co., Minneapolis, Minn., has announced the development of the Model 400 BT transformer-type a.c. arc welder which has capacity ranging from 30-350 amp., with a separate tap for each of the 19 heat stages. It is claimed that the transformer in this

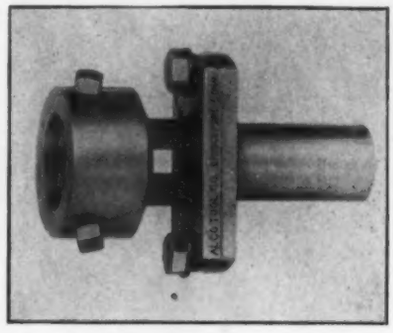


welder will operate at full capacity continuously, and will deliver a strong stable arc at any heat stage. The truck on which this unit is mounted is equipped with roller bearings.

Compact Spot Welder Suspended from Trolley

Designed to weld work clamped to a form or jig, a spot welder with the welding head, control and automatic switch in a single unit arranged to be

hung from a trolley or portable crane has been announced by the Electric Arc Cutting & Welding Co., 152 Jelliff Ave., Newark, N. J. This unit is intended to fill the demand for a portable welder for use where the cable type is not applicable.

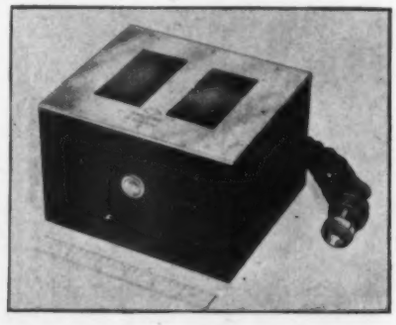


Button-Type Dies Held Concentrically

The improved button-type die holder developed by the Alco Tool Co., Bridgeport, Conn., provides adjustable concentric alignment with only three setscrews instead of the usual five. It is claimed that this design, used in conjunction with a floating member, results in considerably shortened set-up time and greater accuracy of alignment. Floating feature permits die to run over work before tightening flange. Increased room is provided for chips, and lubrication has been made easier.

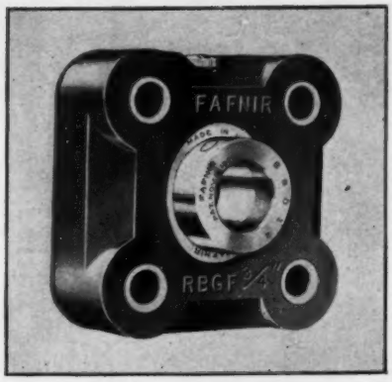
Small Demagnetizer Has Wide Use

H. E. Dickerman Mfg. Co., 284 Wilbraham Road, Springfield, Mass., has



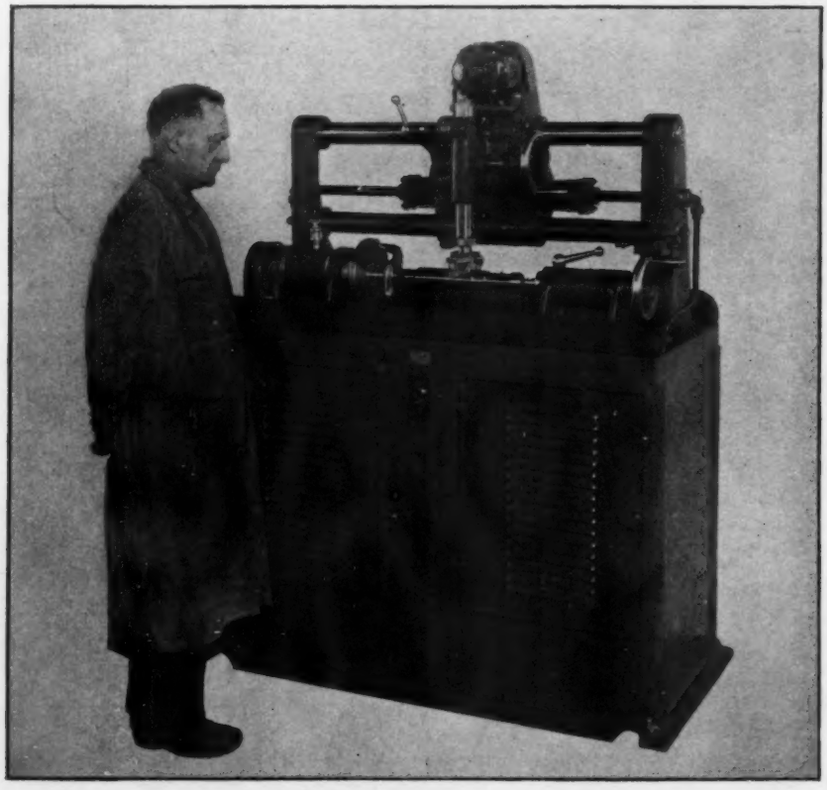
developed a unit for demagnetizing the newer tool steel alloys, such as high-carbon high-chrome steels, cobalt and tungsten high-speed steels and molybdenum steels. It is also suitable for handling parts made of

the usual types of steel. Unit measures 6½ x 5½ x 4½ in., with the two 3 x 1½-in. poles spaced ⅞ in. apart. It operates on a 110-volt a.c. supply from 25 cycles to 60 cycles. Net weight is 11½ lbs. Capacity of the unit is not limited by its size; by placing the demagnetizer over large work, parts of almost any size may be demagnetized.



Rubber Pillow Blocks Aid Silent Operation

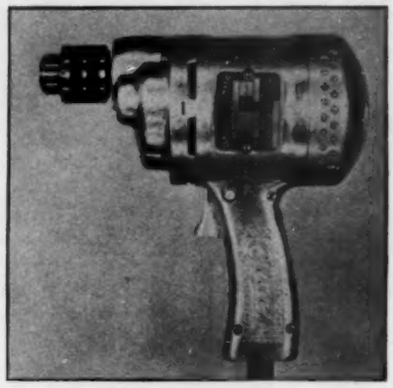
All-rubber pillow blocks developed by the Fafnir Bearing Co., New Britain, Conn., are now available in both flange and cylindrical cartridge units, making them suitable for many applications. The resilient housing is claimed to insulate the bearing, absorb noise and vibration, and automatically compensate for small errors of alignment and longitudinal shaft expansion. Both flanged and cylindrical cartridge types are available for standard shaft diameters from ¾ to 1 7/16 in. Each embodies a wide inner ring ball bearing with self-locking collar.



General-Purpose "Superfinisher" Available for Cylindrical Surfaces

A general purpose "Superfinishing" machine for performing this operation on cylindrical surfaces up to 4 in. in diameter and 18 in. in length, and 6 in. in diameter on shorter lengths, has been announced by Foster Machine Co., Elkhart, Ind. The headstock of this machine may be equipped for either center, collet, or chucking work. Drive to the spindle is obtained through a variable speed transmission mounted in the base of the machine. Transmission is arranged for an indefinite number of spindle speeds up to approximately 550 r.p.m.

The machine has been adopted to a wide variety of work, including airplane parts, automobile parts, tools and dies, and other similar parts. It is especially suited for superfinishing leader pins and die sets, broaches and reamer flutes, cylindrical gages, draw mandrels, pump pistons and shafts, motor armature shaft bearings, and similar work. It is possible to obtain surfaces reading as low as 2 microinches.

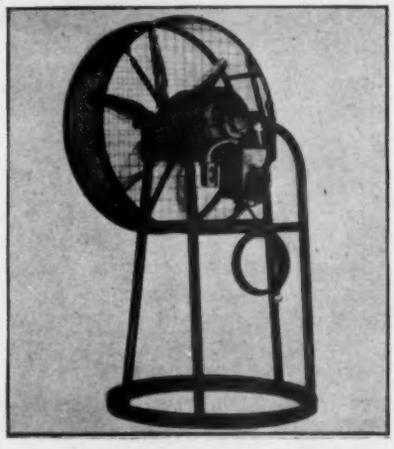


Portable Drill Has Light Weight

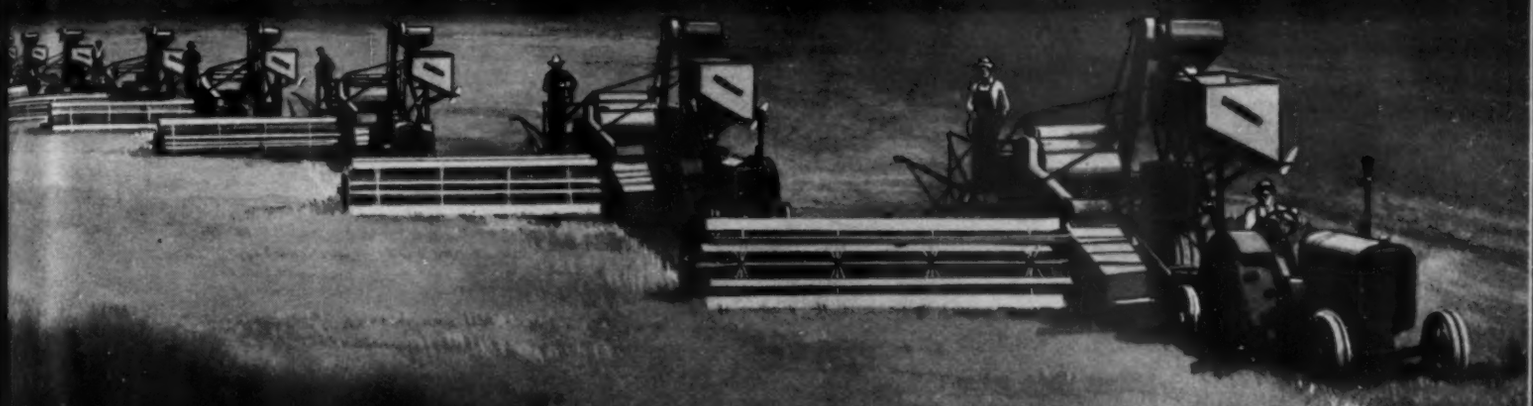
The Model 3012-S ¼-in. portable electric drill offered by the James Clark, Jr., Electric Co., 600–640 E. Bergman St., Louisville, Ky., has been especially designed for use in the aircraft industry. Frame, gear plate and gear head are cast from a special aluminum alloy, resulting in a total weight of only 5 lb. Ball bearings are used throughout. Specifications: no load speed, 2,000 r.p.m.; approximate full load speed, 1,200 r.p.m.; over-all length, 7¾ in.; standard voltage, 110.

"Aerospot" Fans Solve "Hot-Spot" Problems

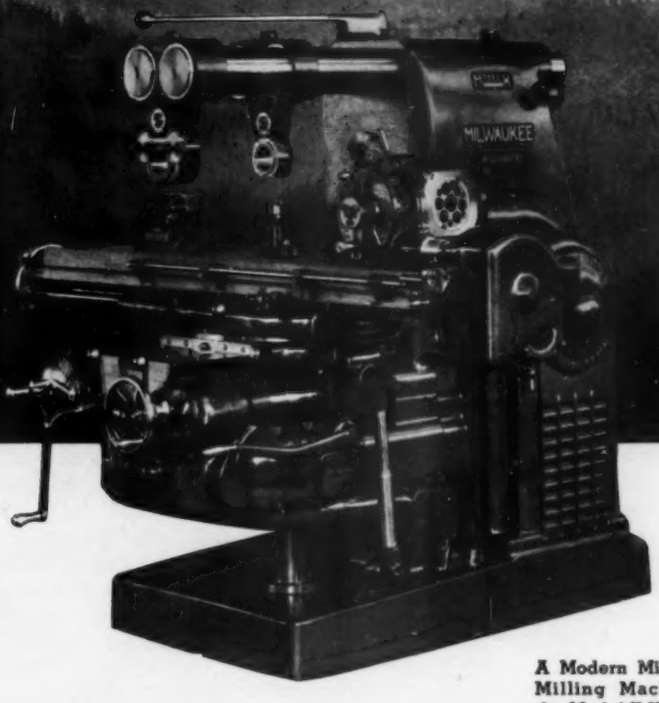
Developed especially for man cooling service in large industrial plants, the "Aerospot" fan announced by South



THE *Modern* TOOLS OF AGRICULTURE



MECHANICAL FARM HANDS - - - *BUILT WITH MODERN MACHINE TOOLS*



A Modern Milwaukee Milling Machine — the Model K Universal

AMERICAN agriculture leads the world in productive capacity because of tractors, combines, plows and other machines that multiply individual man-power. You can expect increased productive man-power in your plant with modern Milwaukee milling machines.

KEARNEY & TRECKER CORPORATION
MILWAUKEE, WISCONSIN, U.S.A.

MORE THAN 41 years OF DOING ONE THING WELL

K&T

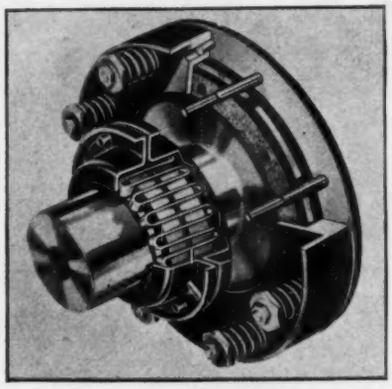
Milwaukee MILLING MACHINES

Bend Air Products, Inc., 322 E. Colfax Ave., South Bend, Ind., are furnished in capacities ranging from 3,000 to 26,500 cu. ft. per min. Each is equipped with a magnetic starter and pushbutton control. Ball-bearing, fully-inclosed motors are used. Frame is fabricated of heavy welded steel tubing with a rolled angle ring base. Fan has forged aluminum alloy blades.

Compact Units Drive Machines

Including units especially designed for driving punch presses, milling machines, shapers and lathes, the "Masterdrive" units announced by the Industrial Equipment Division, Master Electric Co., Linden and Master Ave., Dayton, Ohio, combine

a geared head motor and a superstructure in a single unit which can be attached easily to the machine tool. There are six standard units arranged for punch press drive, five for shapers, five for milling machines, and five for lathes. These range from ¾ to 5 hp. capacity.

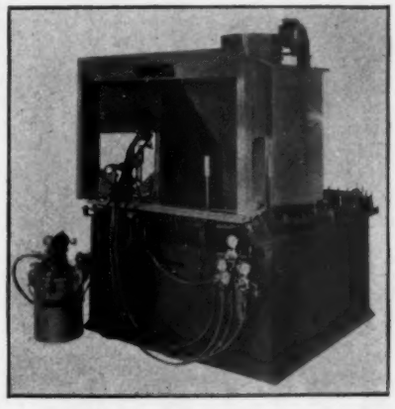


"Steelflex" Coupling Gives Shock Protection

Designed to protect mechanical drive systems against damage caused by shock overloads, the controlled-torque "Steelflex" coupling developed by the Falk Corp., 736 Park St., Milwaukee, Wis., consists of a "Steelflex" coupling combined with an adjustable-pressure friction clutch. This coupling affords protection against peak loads ranging from 500 to 1,000 per cent of normal torques. In addition to its ability to slip under instantaneous high peak loads, this coupling also performs the usual functions of a resilient coupling, such as damping out shocks, reducing vibration, and compensating for shaft misalignment.

Automatic Finisher Has Traversing Gun

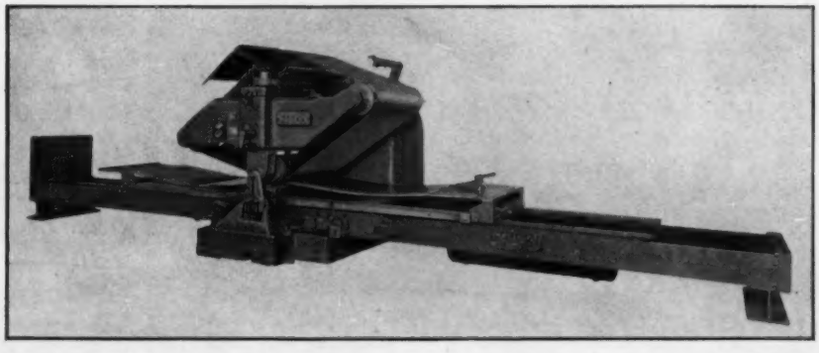
Adaptable to all types of automatic spray finishing for clocks, battery boxes, balls, insulators, lamp fixtures and many other similar items, the standard automatic spindle-type spray ing machine introduced by the Binks Mfg. Co., 3114–26 Carroll Ave., Chicago, Ill., is arranged so that the spray gun is operated only when it is following revolving products to be finished. This machine uses the "Thor" Model No. 21 automatic spray gun

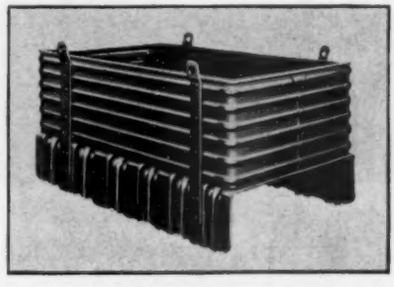


connected with a three-way valve that operates the gun. The spindles are carried past the gun position by a continuous chain. The unit can be furnished with either a dry or water-wash-type spray booth.

Sheet Grinder Uses Factory-Coated Belts

The No. 455 wide-belt sheet grinding and polishing machine developed by the Mattison Machine Works, Rockford, Ill., has been specially designed for using factory-coated abrasive belts for grinding stainless steel and other alloy sheets. Attention has been given to securing maximum life and efficiency from the belt, with the unit incorporating necessary weight to assure the stability required for smooth surfacing. Belt is controlled automatically and oscillated on the rolls, with the design such that it may be replaced easily. Pushbutton stations and other controls are conveniently located at the front of the machine. Units are built to carry belts up to 50 in. wide for processing sheets up to 48 in. wide and 14 ft. long.





Lift-Truck Platforms Use New Corrugations

Double-corrugated construction is used for the all-steel lift truck platforms announced by the Union Metal Mfg. Co., Canton, Ohio. These skid platforms are available in all the customary types. Corrugations consist of two half-round recesses joined by a raised center rib. Both recesses and raised rib traverse the entire deck of the platform, rolling over the knee and down the legs in a gradual curve. This construction is said to give added strength at the knee, where failure

Announcing the 1939

MACHINE TOOL SHOW

THE GREATEST EXHIBIT OF THE TOOLS OF INDUSTRY EVER PRESENTED

Cleveland

OCTOBER 4-13, 1939

NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION

10525 CARNEGIE AVENUE, CLEVELAND, OHIO.

EXHIBITS

The 195 exhibits, occupying 150,000 square feet of floor space, will display nearly 1,000 machines. These will include every type of machine tool in its most modern form, and in full operation . . . also many types of allied equipment and accessories. Every facility will be afforded visitors for careful, thorough inspection.

MACHINE TOOL CONGRESS

A Machine Tool Congress, sponsored by the professional engineering societies, will be held in evening sessions during the period of the Show. Foremost authorities will speak at the forum meetings of this Congress, on important developments in manufacturing methods.

ATTENDANCE

Attendance will be limited to qualified visitors. Admission to the Machine Tool Show will be by registration only. Among those attending will be officers and directors of manufacturing companies, operating executives, engineers, production men, buyers. More than 50,000 people visited the Machine Tool Show of 1935.

YOUR SMARTEST INVESTMENT TODAY . . . MODERN MACHINE TOOLS

usually occurs. The center rib also acts as a knee brace, as an integral bar brace in the deck, and as a bar brace stiffener in the legs.

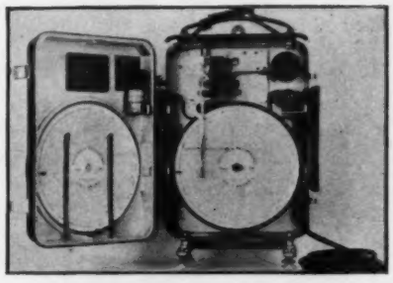
No. 161-L "Timeter" Has Indicating Lamp

Operation of a machine to which a Model 161-L "Timeter" has been connected can be determined at a glance, since the indicating lamp is lighted only when the machine is

operating. Offered by National Instrument Co., 44 School St., Boston, Mass., this instrument keeps an accurate record of actual production hours for the machine to which it is connected. It can be mounted at the machine, or in a supervisor's office.

Series 3200 Controller Acts Rapidly

A movement of only 0.002 in. of the temperature controlled galvanometer pointer in the Series 3200 potentiometer controller announced by Wheelco Instruments Co., 1929–1933 S. Halsted St., Chicago, Ill., is necessary to produce instant and positive control. The so-called "radio principle" employed in this controller incorporates no mechanical apparatus to be set in motion. These controllers are adapted to actuate any standard type of fuel valve or electric contactor. A built-in signal light indicates control action.

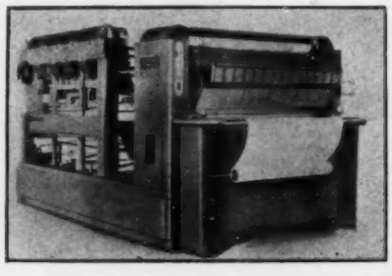


Recording Voltmeter Is Weatherproof

A round-chart portable recording voltmeter, built especially for survey work, has been developed by the Bristol Co., S. Main St., Waterbury, Conn. This Model 522 MS meter is a light-weight, self-contained instrument built in a weatherproof case to enable it to be used outdoors. All parts have been constructed to withstand the rough handling.

Blueprinter Includes Washer and Drier

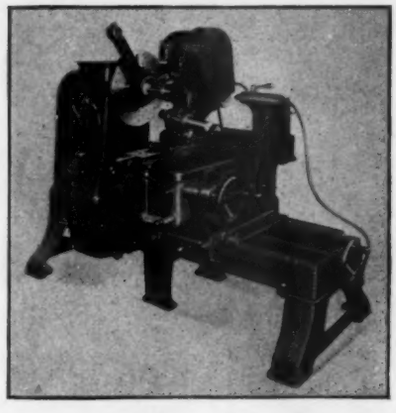
The C. F. Pease Co., 813–821 N. Franklin St., Chicago, Ill., has introduced a continuous blue printing,



washing and drying machine designed for extreme flexibility. Attention has been paid to making all controls readily accessible. The Model 22 uses "Actinic" arc lamps controlled through a switch arrangement which permits the lamps to operate at any one of three speeds as desired. Washer comprises three horizontal water tanks in which the paper floats as it is washed, thus minimizing tension wrinkles and distortion. Nine aluminum drums are used to dry the paper. Production rate of 24 linear ft. per min. on d.c. power or 18 linear ft. per min. on a.c. is available for large tracings. On smaller tracings the speed control permits the use of a slow speed paper.

Turret-Head Machine Grinds and Turns

A turret-head grinder that can be quickly arranged for turning has been announced by Lempco Products, Inc., Bedford, Ohio. Known as the "Du-All," this unit has a 50-in. swing and may be used for internal, external and face grinding and turning. Four spindle speeds and three feed ratios are changed by means of a lever. Standard length of bed is 6 ft., although models can be supplied with bed of any length. With the 6-ft. bed



the distance between work centers is 44 in. Turret head containing the cutting tool and grinding wheel is mounted on the cross slide and swivels on a diagonal plane.

Saw Blade Carton Protects Blades

Precision saw blades for "Doall" sawing machines, when in 100 ft. coils or larger, are packed in a carton which permits stripping the blade through an opening in one corner, meanwhile protecting the coil against

damage and against rust while stored in the stockroom. Offered by Continental Machines, Inc., 1301 Washington Ave., S., Minneapolis, Minn., these cartons are marked with a five-letter code to distinguish the some 300 different types of precision narrow blade band saws available.

Special File Developed For Stainless Steel

A file with teeth having extra resistance to the abrasive effects of such tough, dense metals as stainless and other alloy steels has been made available by the Nicholson File Co., Providence, R. I. Used with a light pressure and a slow, steady stroke, these files are claimed to remove the metal rapidly and to leave a good finish. They also are said to last much longer on alloy steels than general purpose files. These files are made in the same shapes and sizes as general-purpose files.

Lacquer Retarder Prevents "Blushing"

A retarder to prevent "blushing" or "blooming" of nitro-cellulose lacquers when drying on damp days has been announced by The Enthone Co., 442 Elm St., New Haven, Conn. This retarder is claimed to overcome blushing troubles during days of high humidity whether lacquers are applied by spraying, brushing or dipping. Compound has wide resin tolerance and high nitro-cellulose solvency, thus making it compatible with nearly all lacquers. It is claimed not to slow up the drying time unduly.

TRADE PUBLICATIONS

ABRASIVES Specifications of an extensive line of abrasive papers and cloths are included in a 40-page illustrated price list and catalog published by Abrasive Products, Inc., South Braintree, Mass.

AIR COMPRESSORS Type 20 high-pressure air compressors for start-internal combustion engines are described in an illustrated leaflet, No. 2437, issued by the Ingersoll-Rand Co., 11 Broadway, New York, N. Y.

BELT COUPLINGS "Moran's" steel belt couplings for fastening round belts are described in a leaflet issued by Greene, Tweed & Co., 101 Park Ave., New York, N. Y.

CENTERS Several types of precision "frictionless" live centers are described in a folder now being distributed by the J. C. Glenzer Co., 6463 Epworth Blvd., Detroit, Mich.

CHAIN Moline Malleable Iron Co., St. Charles, Ill., has published an illustrated catalog which includes specifications and prices of many types of chains, chain attachments, and accessories.

COMPRESSORS Design features and specifications of a line of single-stage horizontal air compressors are provided in a 12-page illustrated bulletin, No. 184, issued by the Pennsylvania Pump & Compressor Co., Easton, Pa.

DEMAGNETIZER The Blanchard Machine Co., 64 State St., Cambridge, Mass., has published a circular, Form No. 213, describing the features of an adjustable gap demagnetizer.

DIE HEADS Features and specifications of an extensive line of heat-treated die heads are provided in a 16-page illustrated booklet, No. F-90,

MORE PRECISION WORK

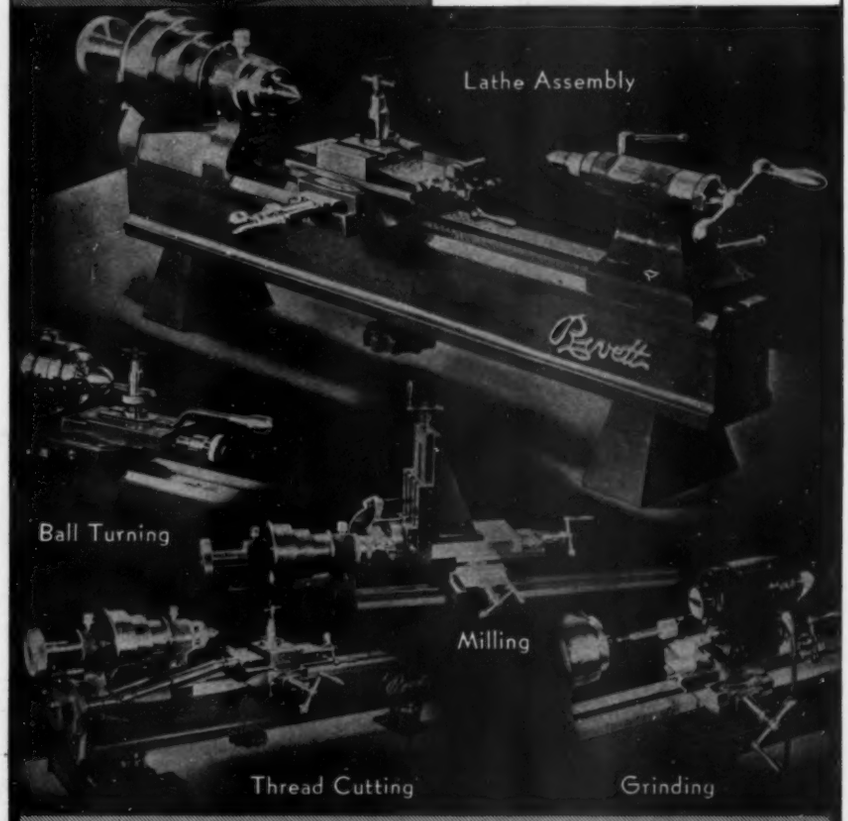
On Rivett 505

The correct lathe can be furnished in the 505 series for any production, tool room or experimental bench lathe work. A new 24 page bulletin covers the various sizes of plain, ball and roller bearing lathes, their complete line of attachments, mountings and drives.

Become acquainted with the possibilities for **MORE PRECISION WORK** in your shop on Rivett 505 plain bench lathes.

Write for Bulletin 505-E

RIVETT LATHE & GRINDER INC.
Brighton, Boston, Mass.



RIVETT

issued by the Landis Machine Co., Waynesboro, Pa.

END MILLS An 8-page pamphlet now being distributed by the Union Twist Drill Co., Athol, Mass., provides specifications of a line of double-end, single-end, and ball-end end mills.

GRINDING A number of remanufactured grinders and other machine tools are described in "Better Grinding Less Investment," a folder published by the Hill-Clarke Machinery Co., 651 Washington Blvd., Chicago, Ill.

HAMMER An illustrated folder released by Greene, Tweed & Co., 101 Park Ave., New York, N. Y., describes the "Basa" rawhide hammer. A revised price list has also been issued concerning these tools.

MAGNETS Bulletin No. 25-A, issued by the Stearns Magnetic Mfg. Co., Milwaukee, Wis., describes a line of suspended magnets for handling small articles.

MATERIALS HANDLING Bulletin No. 98, issued by the Gifford-Wood Co., Hudson, N. Y., provides 24 pages illustrating numerous installations of various types of conveying equipment.

MICROMETER A line of internal micrometers is described in an 8-page illustrated booklet issued by John Bath & Co., Worcester, Mass.

MOTORS. General features of Westinghouse motors are pointed out in Folder F. 8475, released by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

NICKEL Bulletin No. T-13, published by the Development & Research Div., International Nickel Co., 67 Wall St., New York, N. Y., contains 32 pages of revised data concerning nickel and nickel-base alloys.

PAINT MIXER A four-page folder cataloging a line of air-motored agitators has been issued by the Pneumix Div., Eclipse Air Brush Co., 398 Park Ave., Newark, N. J.

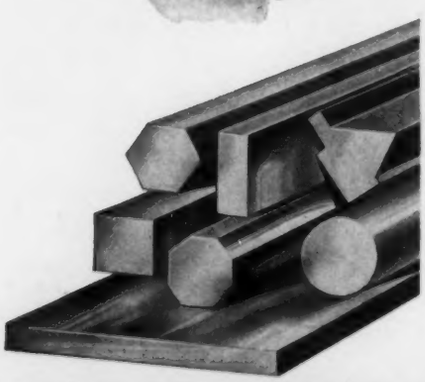
POWER TRANSMISSION Catalog M, published by the Baldwin-Duckworth Chain Corp., Springfield, Mass., comprises 120 pages of engineering data concerning an extensive line of chains and sprockets for power transmission, conveying and elevating applications. Included are discussions of various design features and recommendations dealing with the use of these units and their accessories.

PRESS BRAKES Bulletin No. 940-B, released by the Long & Allstatter Div., Columbia Machine Tool Co., Hamilton, Ohio, describes features and provides specifications concerning an extensive line of steel power press brakes.

PUMPS Bulletin No. W-321-M3A, issued by the Worthington Pump & Machinery Corp., Harrison, N. J., describes features of the "Jetflo" line of deepwell pumps.

REAMERS Bulletin No. 39, issued by the Wetmore Reamer Co., Milwaukee, Wis., illustrates several types of heavy-duty reamers.

TOOL PERFORMANCE "Performance Data," a compilation of performance data sheet concerning the Gisholt line of machine tools, is now being distributed by the Gisholt Machine Co., 1201 E. Washington Ave., Madison, Wis. Additional leaves for the binder will be distributed regularly to keep the information up to date.



You can always depend on Wyckoff for any cold drawn steel specification. Whether you require standard SAE ratings or whether your job demands a steel of unusual metallurgical characteristics or exceptional accuracy as to size and shape, remember Wyckoff can serve you superlatively well through a nationwide network of Distributors carrying complete Warehouse stocks—a service as near as your telephone.

WYCKOFF DRAWN STEEL COMPANY

FIRST NATIONAL BANK BUILDING, PITTSBURGH, PENNA. — 3200 SO. KEDZIE AVENUE, CHICAGO, ILL.

Mills at Ambridge, Pa. and Chicago, Ill. . . . Warehouse Stocks in Principal Cities

Manufacturers of Carbon and Alloy Steels . . . Leaded Steels . . . Turned and Polished Shafting . . . Turned and Ground Shafting . . . Wide Flats up to 12" x 2"

SEEN and HEARD

JOHN R. GODFREY

Pride Is Still There

Those who claim that pride in the job went out with the passing of the small shop, have been visiting the wrong kind of shops. It was "ladies' night" at the bowling club of a large plant, where the super bowls with his men. He's Mister in the shop but just "Bob" when he's knocking the pins. When the games were over, Jim, one of his lathe men, asked if he could take his wife into the shop on the way home to show her that special job he had in the lathe. It was a difficult job and he was proud of it, with good reason. The super is betting that Jim's stock went up several points in the home market.

Milling on a Planer

We have all seen stationary tool heads mounted beside a planer to machine parts that could not be reached by tools on the cross or side rails. As a rule work of this kind is too large to be handled between the housings. A variation of this was seen recently in the Crocker Machine and Foundry Company in Gastonia, N. C.

Having a lot of steel plates to be machined on one edge, this company built a sturdy milling spindle head and mounted it beside the large planer. With the plates to be machined clamped to the table the edges were surfaced by feeding them past a good sized, inserted tooth milling cutter. The proper table feed was secured by introducing suitable worm reduction gearing in the table drive. This virtually made what we used to call a "rotary planer."

Incidentally this shop had one of the cleanest foundries I have ever seen. Sand was piled in neat, uniform rows; flasks and other paraphernalia were neatly stacked. The whole foundry, while comparatively small, gave the impression of efficient supervision.

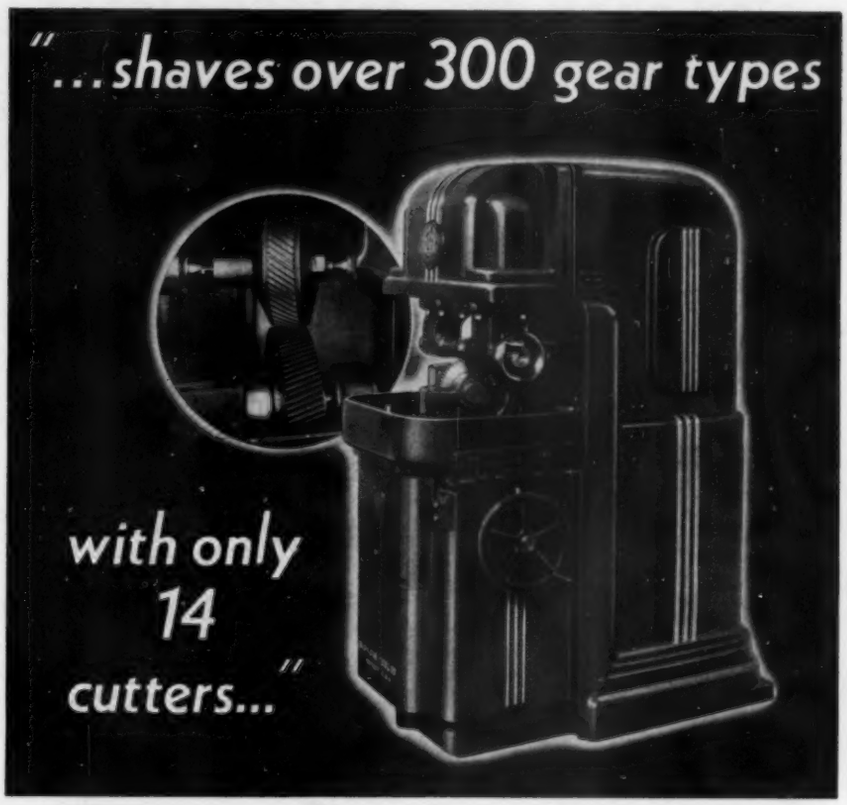
Cheap Reducing Gears

Automobile junk yards are no ornament in any community. But local machine shops occasionally find uses for used car parts that the designers never contemplated. One such use, which I have found in several southern shops, is for gearing to use in connection with machine tools or other machinery. A particular application is the use of the three-speed transmission of a standard car for giving three ranges of speeds on a special grinding machine. A sturdy automobile transmission will transmit more power than we often put into a machine and, when secured from an auto salvage dealer, the cost is low.

Saved $10—Lost $5,000

This is one of those believe-it-or-not stories, but it's vouched for by an engineer so it must be true. The tool crib man had complained that the shop needed some new "mikes." The old ones had seen a lot of use, and he had no gage blocks to check them. But the man with the check book thought they had been good enough for several years and ought to last a while longer. And ten dollars was a lot of money for one small tool.

Then a really fussy job came along that had to be right within a thousandth. It was a big order, and the men went to it with a vengeance. According to the story the mikes were enough out step with the real size to spoil $5,000 worth of work before the customer checked them with his own gages. If the mikes were worn large, the pieces could perhaps have



Using Michigan 860 type gear finishers, FULLER MFG. CO., producers of bus, truck and industrial transmissions, and special gearing, has found that with but 14 cutters it can shave every one of its more than 300 "active" gear types at a lower cost than for finish hobbing or shaper-cutting . . . while obtaining the greater quietness, greater accuracy, longer life, and faster production, which characterize MICHIGAN-shaved gears.

Combined set-up time for gear shaver and MICHIGAN gear checking equipment for each new run at Fuller averages only 30 or 45 minutes, depending on whether or not cutters are changed.

Regardless of your production quantities, if you are interested in better gears at a lower cost, it will pay you to investigate MICHIGAN gear finishing equipment. There is a representative in your area.

Bulletins available on Rack-Shavers (high production); 860 shavers (job lots); Checking equipment; lapping machines; Cone area-contact worm gearing; gear cutting tools.

MICHIGAN TOOL COMPANY 7171 E. McNichols Rd., Detroit

been salvaged by regrinding. But that isn't the way I heard it.

Clean Windows

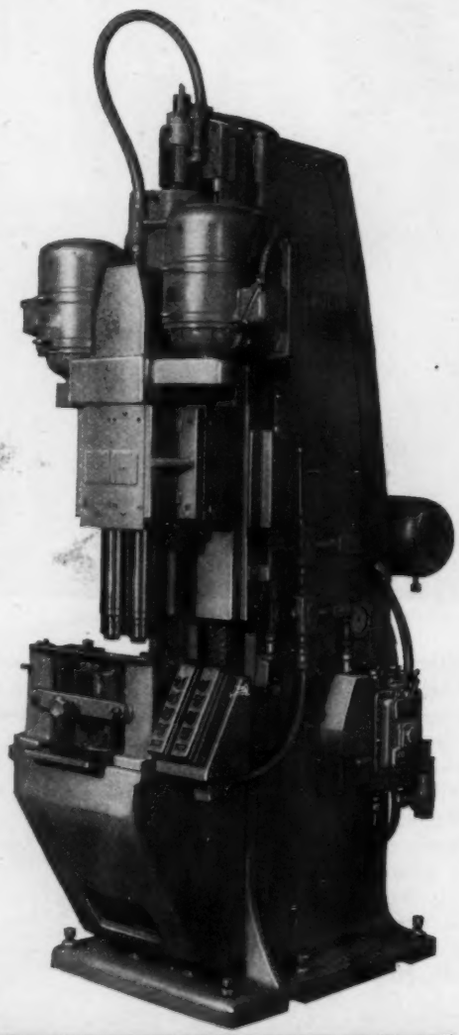
Shop lighting is an important factor in production, accuracy and safety. And in these days of light meters there need be no guesswork about it. Light can be measured the same as temperature or humidity. Lighting engineers can prescribe not only the amount of light but the kind and location of lighting units to give the desired result.

Too many shops however overlook one light factor that not only affects results, but costs as well. Clean windows help out on the bills for current, but are too often not considered seriously. One large shop has contracted for a monthly bath for the windows at a fixed price per pane of glass. They find that it not only pays in reduced bills for current but also peps up the morale of the men.

Shafting Gages

A small shop in a southern city does quite a business boring pulleys for the adjacent territory. Many of these are for farmers whose ideas of fits and measurements are a bit vague. So the shop has a line of cheap plug gages of each standard size of shaft used in that territory. These gages are simply 6-in. pieces of standard shafting with an eyebolt screwed in the end. The eyebolts serve as handles and make it easy to hang the gages on the wall directly behind the lathe where the pulley boring is done. Each is stamped with its diameter and pulleys are bored to a good fit on that gage. It saves a lot of disputes.

OILGEAR FEEDS *IMPROVE* MACHINE TOOL PERFORMANCE



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NEW BOOKS

THE KNACK OF SELLING YOURSELF.—*By James C. Mangan. 234 pages, 5¼ x 8 in. Clothboard binding. Published by the Dartnell Corporation, Ravenswood and Leland Ave., Chicago, Ill. Price,* $2.50.

"Make the most of your capability" is the text of this volume. The author does not waste time on the success stories of prominent men, but directs himself to the reader with practical instructions as to how to get along in life.

Personal salesmanship, according to this volume, involves proficiency in eight fundamentals; expression, promise, guts, approach, diplomacy, familiarity, reliability and persuasiveness. The author develops these fundamentals in detail and translates them into terms of everyday life. From the clothes one wears to the way one talks, all the habits and mannerisms that determine the individual's impression upon the society in which he lives are analyzed and their effects on his success pointed out.

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MACHINERY HANDBOOK—(*Tenth Edition*). 1815 *pages, 4½ x 7 in. Indexed and Illustrated. Limp leather binding. Published by the Industrial Press,* 148 *Lafayette St., New York, N. Y. Price* $6.00.

Enlarged and revised, this standard reference work has been brought up-to-date better to fit the needs of those interested in the design and construction of mechanical products. It contains 250 pages of material not found in the last edition.

In addition to the wealth of standard reference data, the new volume includes information on grinding wheel shapes and dimensions, forming tool blanks, standard mounting dimensions for various types of motors, selection of tool steels, and steels for gearing, brass, bronze and non-

metallic gearing, revised hardness conversion tables, lubrication of bearings, standard V-belt drives, and a great deal of other data that has been developed or standardized within the past few years.

The information is conveniently arranged in 134 main divisions to enable the user to locate the references easily.

The editors, Erik Oberg and F. D. Jones, have been guided by their daily contacts with developments in the field of metal-working manufacture. As in the past, their objective has been to prepare a convenient compilation of fundamental engineering information that will be of maximum help to the designer and the production man.

That Time-Study Restriction

By FRED H. COLVIN

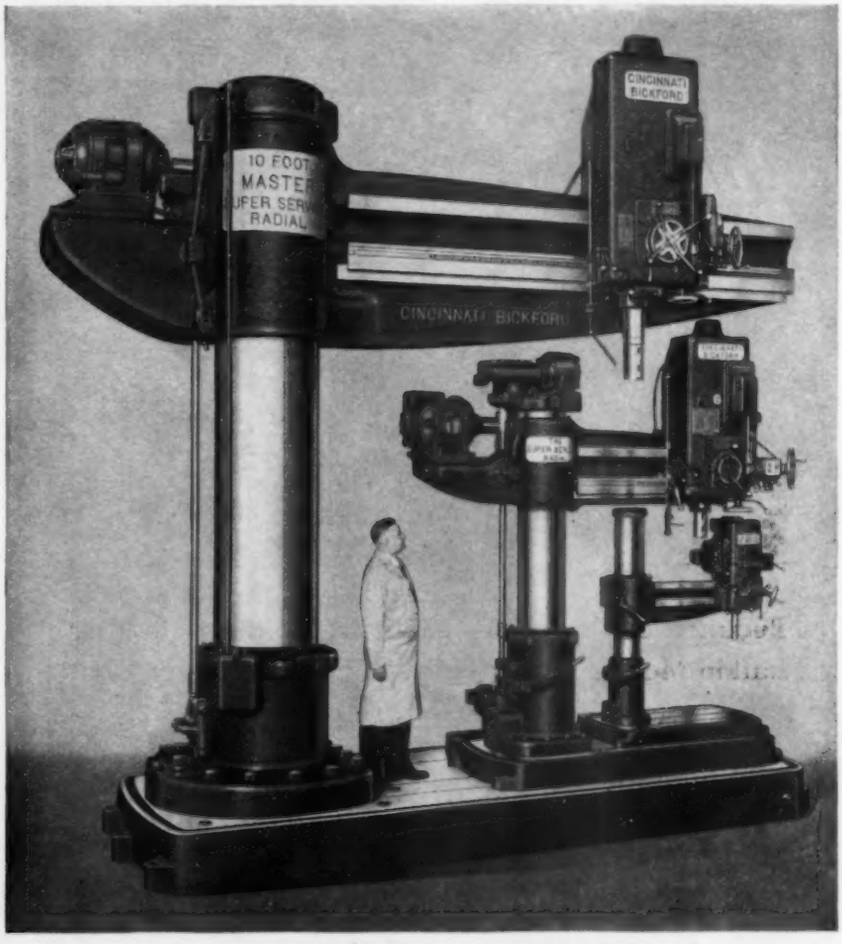
Time and motion study got a black eye early in the days of scientific management largely because the advocates overlooked the human reactions to the methods they employed. Time study was not new. It began with the introduction of piece work, which dates back almost to the beginning of industrial development. Few probably broke the study down into elements of motion as did Taylor, and later Gilbreth with his motion photography. But time study began long before that.

It was the methods used both in making the studies and in utilizing them which roused the strenuous opposition that was sufficient to force the introduction of the clause prohibiting "the use of stop watch or other time measuring device" in connection with machining time on all government contracts. Men who understood human nature, who knew the prides and prejudices of men in the shop, could and did introduce modern time study into shops with full cooperation of the men.

Most of the early disciples of scientific management antagonized men not only by their methods, but also by the assumption that all intelligence was confined to the planning department. When skilled men, who had handled intricate machine tools for years, were given detailed instruction as to how work was to be handled, when to use right or left hand and other orders that assumed they were simply attachments to the machine, they naturally resented it. Instead of cooperating, they bucked the new methods at every turn. And a shopful of resentful men can gum the works on even the best of plans.

But in spite of the fact that this resentment was aroused many years ago, the prohibition of time study on government work still stands. Just how much this affects the cost of production on government work is hard to say. Some of the government arsenals and shipyards will show an efficiency that compares with other plants handling similar work on the same production basis. As with private plants, efficiency depends largely on the kind of management. The best management secures cooperation and economical production, regardless of the system of payment. All have some method of measuring output whether day-work, piece-rates or bonus are in vogue. Such large production plants as those building automobiles have gone back to day rates.

It is fairly safe to say that the clause against time study now makes very little difference in the speed at which government work is done, or its cost. It is also doubtful if it would be wise to try and repeal it at this time. Although passed at a time when feeling ran high in labor circles and



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now almost a dead letter, any attempt to repeal it would probably arouse suspicion as to the reasons for such action. Militant labor leaders would immediately suspect some ulterior motive, which might tend to slow production until convinced that no "speed-up" was in sight.

Both the original antagonism to time study and the probable effect of any attempt to repeal the restriction emphasize the necessity for greater cooperation and understanding between labor and management. There is no use in questioning the right to organize and bargain collectively. But when management and labor understand each other's problems and earn each other's confidence, there will be less talk of "rights" and more thought of cooperation, as benefiting both sides.

Uncle Henry and the Hair Clippers

By H. M. LANE

H. M. Leland worked for the Brown Barber Company in Providence, Rhode Island, for many years. When he was a boy in school, his older brother's wife had a baby and at once all his chums dubbed him "Uncle Henry". The name stayed with him for over sixty-five years.

One day Mr. Brown came to Uncle Henry with a new device that he wanted made in Mr. Leland's department. It was a horse clipper operated by two long handles with wooden pieces on them like file handles. Uncle Henry was a man strong for that which he believed to be right. He thought that man had no right to interfere with the wise provisions of the Almighty in regard to animals; hence, the horse's hair was an overcoat that the Good Lord had given the poor beast to protect him. Acting on this belief, he refused to make the clippers and declared he would quit his job first. Mr. Brown labored long with Uncle Henry before he convinced him that the clippers would be made by someone, whether he stayed on his job or not. So finally, under protest, he made them.

In less than a week, a barber came to him with a set of the clippers and asked him if he could change one of the handles so that the fingers of the right hand could be put through a hole in them and the other handle arranged so that it could be operated by the thumb of the right hand, the handles being kept apart by a spring so that the clippers could be operated with one hand. This made a fairly efficient pair of clippers for a barber's use. Shortly, almost every barber in Providence came to have clippers fitted for single hand operation.

Then Uncle Henry designed and made drawings for a smaller set which became the standard barbers' clippers. He took it to Mr. Brown and suggested that the firm manufacture them. Mr. Brown said, "I thought that you were thoroughly opposed to the making of clippers". Uncle Henry replied, "Men can choose whether they are to be clipped or not, but the poor animals have no choice." So the clippers became a standard article with the Brown Barber Company and a very profitable one.

Uncle Henry worked out an elaborate inspection for the clippers. He found that calfskin had the fine hair of any animal that he knew of, so he got calfskins and mounted them on boards. To test the clippers, the blades were thrown to one end of their travel, the clippers thrust into the hair and released to make one stroke. The clippers were then drawn out and all loose hairs blown off. If a single hair was caught between the blades, that pair of clippers went back to be refitted.

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TAPES — RULES — PRECISION TOOLS

Three Ways to Learn

By GORDON W. RICHARDS

They tell us apprentices that there are supposed to be three standard ways of learning. First, you can learn by *doing*. Second, you can learn by *reading* about it. Third, you can learn by *watching*. Now we don't know but it seems to us that most of us do our "learning" by the first and second methods only. The third way seems to be forgotten.

Doing it yourself is undoubtedly the best of the three. Reading about how to do it is the next best thing. But have you ever watched old George set up a difficult cam job on the milling machine? Who says there isn't something to be learned in efficiency there? Usually we walk right by. The boss is in a hurry for that templet we are working on. That, or perhaps we are afraid of being caught "loafing." So George's ingenious set-up goes unnoticed. And we have lost something.

Why shouldn't the instructor or foreman keep an eye open for those freak jobs that pass through the shop now and then. When they do, let them call the class together to watch, to see how a real machinist works.

Plastics in Automobiles

Before they can be used as raw materials for the automobiles of the future, plastics must be given the strength and rigidity of alloy steel, the ease of forming and shaping of potter's clay, the toughness of sugar maple and the high precision surface finish of tool steel, said Gordon Saunders, staff officer of Chrysler Corporation, recently.

The automobile industry, he remarked, as yet appears skeptical of the possibility that anything so far accomplished for plastics can take the place of steel in fundamental and structural parts of a car. Mr. Saunders continued:

"If plastics are to be adopted as a major material, they must possess tensile strength of at least 40,000 lb. per sq. in. to compete with body steel; the compressive strength should equal this; and the sheer strength should reach a figure at least three-fourths the tensile strength.

"Decorative plastic materials attached to metal parts should possess coefficients of expansion near or equal to that of steel, or to whatever metal to which they are attached. Flexible but high strength plastic bonding material might be used as an intermediate material between the plastic decorative material and the metal insert or backing.

"The long heating operation used in molding and forming plastics is unsatisfactory from the standpoint of time during which the dies and press are not working. If the plastic material in the form of sheets or blanks were preheated outside of the press and dies, and then stamped or pressed to the desired shape, the number of pieces per machine and per man could be increased to a point where plastic molding would be feasible for use in the automobile industry.

"Alternative to this would be a material which could be cold formed and subsequently polymerized outside of the dies and press without warping or cracking.

"If plastics are used for body parts, they must have the ability to be repaired in some manner: by gluing, by patching on new material to cover or replace damaged material, by bonding together parts or sections torn apart in a crash, or by heating process similar to the welding of metals, or a plastic which can be used exactly as solder is now used to fill up depressions in metals."

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